SCIENTIFIC AMERICAN

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THE MANUFACTURE OF PAPER.

II.—PREPARATION OF WOOD PULP BY THE SODA PROCESS.

In our first article on the manufacture of paper (SCIENTIFIC AMERICAN of March 19, 1898) we described the preparation of chemical fiber by the sulphite process. Sulphite pulp, as the product is commonly called, would not make good book paper if it were used alone, the stock being too hard. These qualities are due partly to the quality of the wood (spruce) from which it is made and partly to the process of manufacture. Paper made entirely from sulphite pulp would not possess the flexibility and softness which are necessary for taking a good impression in the printing office. These defects are avoided by using two entirely different kinds of wood and two distinct processes in preparing the pulp, and mixing the two grades in certain proportions, according to the quality of paper which it is desired to turn out of the mills.

This softer and more flexible pulp is known as soda pulp. It is prepared from poplar wood cut into chips, which is reduced to fiber by cooking it in digesters in a solution containing about 10 per cent of caustic soda. The poplar logs are brought to the Duncan Mills chiefly from the Adirondacks and Canada. They are converted into

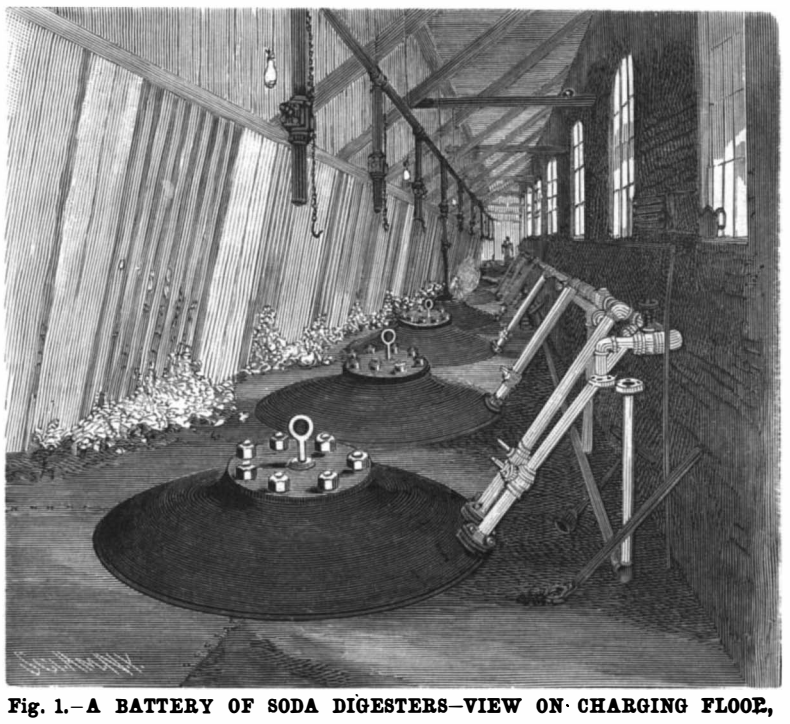

Fig. 1.—A BATTERY OF SODA DIGESTERS—VIEW ON CHARGING FLOOR, SHOWING BINS FOR CHIPS, THE MANHOLES, ETC.

chips in a "chipper," as described in the preceding article, the thickness of the chips in this case being ½ inch, as against a thickness of from ⅝ inch to ¾ inch in the case of the spruce chips. An elevator carries the chips to the second story of the building, from which they pass over an inclined, oscillating screen, where sawdust and foreign matter are taken out, being finally delivered to an elevator which carries them to the long storage bin above the digesters (see Fig. 1).

The digesters are seamless, welded iron cylinders, each of which is 7 feet in diameter and 24 feet long. They stand side by side in a long building, a perspective view of the inside of which is shown in the accompanying illustration. The point of view is at one end of the charging platform, which is located at the top of the digesters. The storage bins for the chips discharge directly onto this platform, from which the charge is run and forked into the mouths of

(Continued on page 277.)

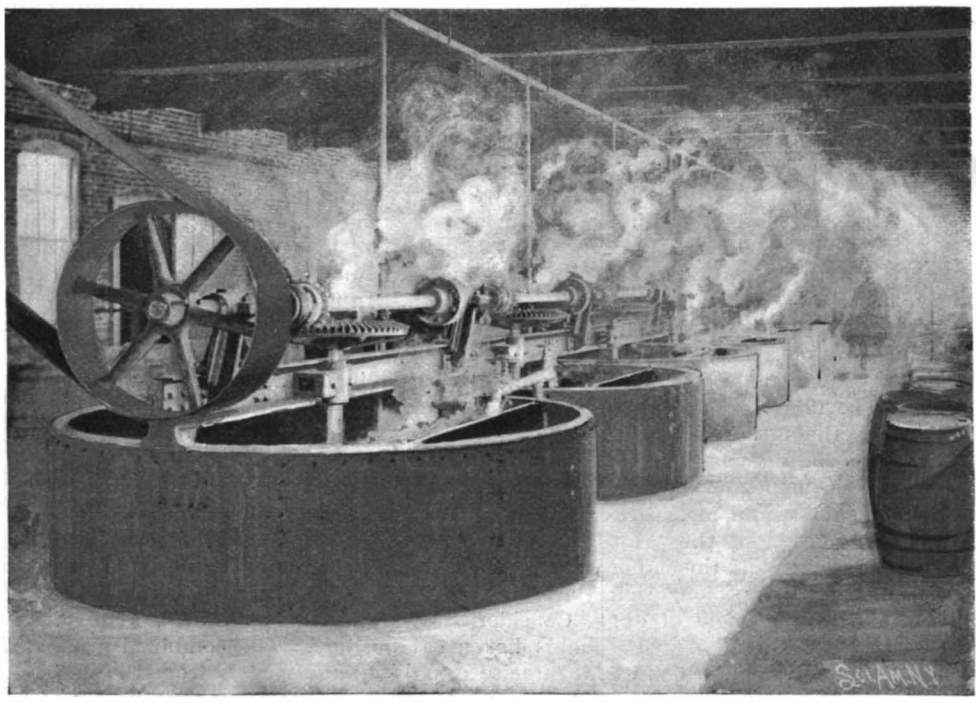

Fig. 2.—THE CAUSTICIZING TANKS FOR TREATING LEACH LIQUOR WITH LIME.

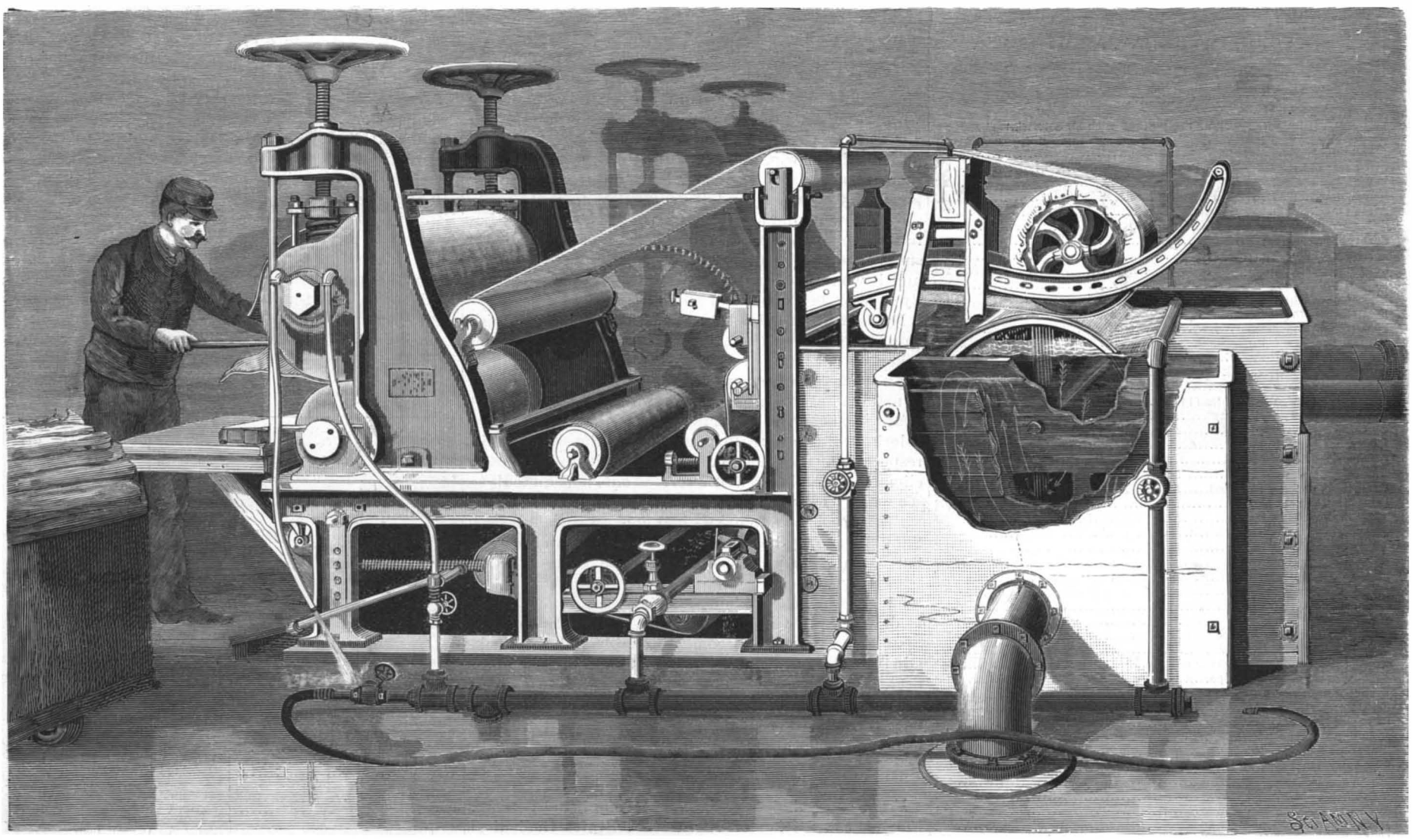

Fig. 3.—WET PRESS, ON WHICH SULPHITE PULP IS FORMED INTO SHEETS FOR THE MARKET.

THE MANUFACTURE OF PAPER.

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NEW YORK, SATURDAY, APRIL 30, 1898.

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THE PACIFICATION OF CUBA.

The war with Spain to which we are now committed has been undertaken, as far as this country is concerned, on humanitarian grounds. The high moral stand which we have taken has met with the unanimous approval of the Anglo-Saxon, or, if the term be preferred, the English-speaking race, throughout the world. Of this there is not the shadow of a doubt, and this sympathy, spoken and unspoken, is as pronounced as are the criticisms which our policy has drawn forth from the Continent of Europe.

Both the President's message and the resolutions of Congress recognize the existence of a great wrong and express the determination to right it. In the resolution there is a strong disclaimer of any intention to profit by the acquisition of territory. We are entering upon a crusade, more practical in its objects, more lofty in its aims, than any that precede it.

It is realized that the first step to the pacification of the unhappy island is the expulsion from it of the Spanish army. This will be accomplished as far as Cuba is concerned whenever a crushing defeat in the field or the cutting off of supplies, whether of food or the munitions of war, or both, forces the Spanish army to capitulate, and as a condition of peace to embark from the island.

From a strategical point of view, considering the object which we have in view, we hold a very strong position. Spain, on the other hand, labors under a tremendous disadvantage. Her fleet is on one side of the Atlantic and a large part of her army shut up on the other side. Our ships are concentrated at the objective point, which is within easy reach of our coaling points, whereas when Spain starts her fleet across the Atlantic she will, in respect of the important item of coal supply, have "crossed the Rubicon" as fatefully as the invader of old. She must win a decisive battle or lose everything—fleet, army and islands—at one stroke.

Will the Spanish fleet cross the Atlantic? We think it will, for the reason that it would be little short of an act of treachery in the eyes of the Spanish people for the government to leave its beleaguered army to be starved or beaten into submission without striking a blow in its behalf. If the full force of Spanish battleships, armored cruisers and torpedo boats be sent over in one combined fleet, it will be necessary for us to meet it with the combined strength of the Key West and Flying squadrons, and upon the outcome of this pitched battle, it is safe to say the issues of the war will depend. A defeat for Spain would mean the destruction of her navy, the isolation of the West Indies, the surrender of General Blanco and the end of the war. A defeat for us would mean a prolongation of the war and a considerable postponement of our ultimate success.

In its early stages, at least, the war upon which we have entered should be regarded as a naval campaign, pure and simple, and, until the first decisive blow has been struck, it would be unwise to make any military invasion of Cuba. The blockade of the island has already been undertaken, and if the latest advices are correct, the Spanish fleets are on the eve of sailing for the West Indies. In this case, the decisive naval conflict should be fought within the next two or three weeks, and it would seem wise to defer the landing of our troops on the island until the issue has been determined. If we win, as in all probabilities we shall, the Spanish army will be cooped up in Cuba beyond the possibility of relief, and its capitulation would probably follow within a very short time. If, on the other hand, the unlikely should happen, and our fleet should suffer reverses, the tables would be completely turned, and it would be our own troops who would, temporarily at least, be cut off and shut up in the island.

By deferring the landing of troops until the Spanish ships have crossed the Atlantic and been destroyed or taken by our fleet, we shall not only avoid what might prove to be unnecessary slaughter, but we shall be able to maintain secure lines of communication and carry out a far more effective blockade of the island. In fact, considering all the conditions governing the situation, irrespective of the question of the unhealthfulness of the climate, which in itself is a serious one, it is difficult to see what end would be served by landing an army in Cuba before the two navies had met on the high seas. Should an army be landed there now, even successful battles would count for nothing if the communication with Key West should be, even temporarily, cut off; while, on the other hand, as soon as the Spanish fleet is driven from the Cuban waters, the position of the Spanish army would become untenable and the blockade would soon put them at the mercy of our fleet. Our army then would be in a position to co-operate with the navy in any maneuvers that might be necessary for the reduction of the island, and it is certain that much useless fighting would thus be avoided.

PRODUCTION OF COAL IN 1897.

From a preliminary statement compiled by E. W. Parker, Statistician of the United States Geological Survey, it is shown that the total output of coal in the United States for 1897 amounted approximately to 198,250,000 short tons, with an aggregate value of $198,100,000—a fraction less than $1 per ton. Compared with 1896, this shows an increase in tonnage of 6,270,000 tons, or about 3·3 per cent. The increase in the value of the product was only $1,700,000, a little less than 0·9 of 1 per cent. The amount of coal produced in 1897 was the largest on record. The average value per ton was the lowest ever known, continuing the declining tendency which has been shown without any reaction for the past six years. The increase in production and the decline in value was confined to the output of bituminous coal. The anthracite production in Pennsylvania decreased nearly two and a quarter million tons, from 54,346,081 short tons of 2,000 pounds (equivalent to 48,523,287 long tons of 2,240 pounds) to 52,122,408 short tons (or 46,537,864 long tons) in 1897, while the average price received at the mines per short ton was $1.65 per short ton ($1.85 per long ton) in both years. This is not an increase, but it is much better than a loss, one cent per ton meaning a total of more than half a million of dollars. In obtaining this average price for anthracite coal per ton, it must be remembered that only marketable sizes are considered, and the item of "colliery consumption," usually consisting of culm, or waste, and an otherwise valueless product, is not included. Excluding this factor, the marketable product of anthracite coal in Pennsylvania during 1897 was 42,637,864 long tons (equivalent to 47,544,408 short tons), against 44,188,460 long tons (49,491,075 short tons) in 1896.

The fact that the bituminous production should have shown an increase of 8,500,000 tons in spite of the prolonged strike in the competitive fields of Pennsylvania, Ohio, West Virginia, Indiana and Illinois (four of them being the largest coal-producing States, aggregating nearly 100,000,000 tons, or more than two-thirds of the entire output), may be taken as an evidence of the wonderful capacity of our developed bituminous mines. Of the twenty-nine bituminous coal-producing States, there were only six in which the production in 1897 was less than in the preceding year. These six were Georgia, Indian Territory, Kansas, Nebraska, Ohio and Oregon. In fifteen of them the output was the largest ever obtained. Of the five competitive States previously mentioned, only one (Ohio) had a decreased production in 1897. In twenty out of the twenty-nine States producing bituminous coal, the average price per ton in 1897 was less than it was in 1896, the general average for the United States being 83 cents in 1896 and 81·6 in 1897. The decline of 1·4 cents on a total product in 1897 of 146,000,000 tons represents a decrease of something over $2,000,000 from what would have been the value if the price had been the same as it was in 1896.

Considering the industry by States, Pennsylvania holds her usual position. The combined product of anthracite and bituminous coals from the Keystone State amounted to 106,000,000 short tons, nearly 54 per cent of the total output. Pennsylvania's percentage of the total bituminous output was 37, her output of soft coal being 54,000,000 tons. Illinois remains in second place, with a total of a little over 20,000,000 short tons. West Virginia comes third, having increased her output nearly 700,000 tons over 1896, and leading Ohio, which comes fourth, by nearly 1,250,000 tons. Alabama reached her maximum output of 5,893,770 tons, and stands fifth. Iowa, sixth, lacked only 85,000 tons of reaching 5,000,000 tons. Maryland produced 4,442,000 tons and Indiana a little over 4,000,000 tons.

The foregoing statement and the following table are based upon actual returns from mines representing 95 per cent of the total product. In cases where returns have not been received, careful estimates calculated upon the production in previous years have been made, so that revision of these figures by later returns will not materially affect the totals.

PRODUCTION OF COAL IN UNITED STATES IN 1897.

State.	Production.	Value.	Average Price per Ton.
Alabama	5,893,770	$5,192,085	0·88
Arkansas	807,207	893,672	1·11
California	89,092	200,866	2.25
Colorado	3,303,449	3,772,520	1·14
Georgia	195,869	140,466	0·717
Illinois	20,072,758	14,472,529	0·72
Indiana	4,019,360	3,416,586	0·85
Indian Territory	1,321,840	1,800,924	1·36
Iowa	4,915,463	5,566,332	1 14
Kansas	2,694,242	3,230,666	1·20
Kentucky	3,906,458	3,170,811	0·81
Maryland	4,442,128	3,387,785	0·76
Michigan	221,792	322,266	1·45
Missouri	2,627,458	2,878,204	1·09
Montana	1,647,999	2,897,642	1·75
Nebraska	495	1,800	3·64
New Mexico	671,879	954,406	1·42
North Carolina	21,280	27,000	1·27
North Dakota	70,175	70 358	1·00
Ohio	12,219,193	9,508,870	0·78
Oregon	100,311	311,550	3·11
Pennsylvania bituminous	53,842,800	37,964,496	0·70
Tennessee	2,880,994	2,316,239	0·80
Texas	619,602	950,713	1·53
Utah	549,646	651,555	1·19
Virginia	1,524,956	1,022,823	0 67
Washington	1,434,112	2,777,687	1·94
West Virginia	13,556,978	8,637,617	0·64
Wyoming	2,483,074	2,676,191	1·08
Total	146,134,380	$119,214,659	0·816
Pennsylvania anthracite	52,122,408	*78,880,048	1·65
Grand total	198,256,788	$198,094,707	

*Excluding "colliery consumption."

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ANNUAL RECEPTION OF THE NEW YORK ACADEMY OF SCIENCES.

BY EDMUND OTIS HOVEY.

The fifth annual reception and exhibition of the New York Academy of Sciences was held on the 13th and 14th of the present month in the American Museum of Natural History, and demonstrated anew the great fitness of holding these affairs in connection with such an institution. The exhibition, which forms indeed the main part of the reception, is intended to be confined to the display of instruments, specimens and other things which will show the progress which has been made in the preceding year in all departments of science, pure and applied. This year the rule was applied much more strictly than heretofore and with excellent effect. The size of the exhibition was greatly reduced from what it has been in previous years, making it more nearly attain the object of the reception and at the same time rendering it more nearly possible for a visitor to grasp what there was to be seen. Probably a still greater concentration of effort in showing only what is really new will make future receptions of even higher value and interest.

The set lecture this year was delivered by Prof. George E. Hale, the director of the new Yerkes Observatory of Chicago University, his subject being "The Function of Large Telescopes." The object of his remarks was to refute the criticism that is sometimes made that the large telescopes are not of sufficiently greater advantage over the comparatively small ones to compensate for their vastly greater expense. In doing this he rapidly reviewed the history of astronomy, showing that many of the most important advances in the science had come through the possession and use of instruments of constantly increasing size and power, the great telescopes revealing characters in the planets and stars, especially double stars, which had not been discovered through the use of the small glasses, and, furthermore, correcting errors due to the use of the smaller affairs. The lecture was illustrated by stereopticon views of the Yerkes and the Lick Observatories and photographs of a few star groups obtained through the great telescopes. Brief addresses were made by Morris K. Jesup, Esq., the president of the Museum, Prof. Henry F. Osborn, the president of the Academy, and Prof. R. E. Dodge, chairman of the reception committee.

The most popular feature of the reception was the exhibition of the properties of liquefied air by Mr. Charles E. Tripler, whose experiments and achievements in this line have received so much notice in scientific and other periodicals in the last few months. Most of those present had seen liquid oxygen in very small quantities during their school days, but it was a thoroughly new experience to all to see cans containing several gallons of the strange liquid and to see it used almost as freely as water. All of the experiments shown brought out the effects due to extreme cold, the temperature of the liquid air being 312° below zero Fahrenheit. Bicycle tubing and sheet tin were rendered as brittle as glass, and a hammer of quicksilver was made in a minute or two by immersing a paper bag full of the metal in the fluid. One of the most striking experiments was the placing of some of the liquefied air in a tin tea kettle and heating it over a gas stove. The air boiled furiously, but its temperature was still so low that it condensed into snow the vapors formed by the combustion of the gas and at the same time made a solid cake of ice of some water that had been put into the kettle with the air. Another strange combination was a tumbler of ice in which some of the liquefied air had been placed, then a fine steel wire, first heated to redness, was burned in it as if in a jar of oxygen. Liquefied air is much richer in oxygen than the ordinary atmosphere is, since in the processes of manufacture and evaporation the nitrogen originally in the atmosphere has been lost more rapidly than the oxygen.

Each of the fifteen departments of science which had a section of the exhibition assigned to it had features of great interest to those making a special study of the branch in question, but space forbids mentioning all here. In the electrical section there was a display in action of American apparatus for telegraphing to a distance without wires on the Marconi system. It is said that this apparatus has worked successfully over a distance of twenty miles. An induction coil giving a spark thirty inches in length, and showing a difference in potential of 1,000,000 volts between its poles, gave a very good representation of artificial lightning. In the section of ethnology and archæology the exhibit of the Jesup North Pacific expedition, showing the results of studies along the northwest coast of America, was the most important. One of the most remarkable exhibits in the whole reception was that of vertebrate paleontology. Here there were the caudal vertebræ and limb bones of a gigantic lizard which the American Museum expedition into Wyoming was fortunate enough to secure last year. The portion obtained is perfect, and represents between 50 and 60 feet of the animal's total length. Mr. Charles Knight has continued making his wonderfully lifelike restorations of Tertiary reptiles and mammals, and a series of his water colors and models was on exhibition. The botanists have been very busy the past year, apparently, for they made a large exhibition of specimens and microscopic preparations of new species, almost all of which are from this country. The chief features of the mineralogical exhibit were a set of choice tourmaline crystals from Haddam Neck, Conn., belonging to Mr. Ernest Schernikow, a large crystal of beryl and some curious groups of calcite crystals belonging to the American Museum of Natural History, and a polished sphere of rutilated rock crystal (quartz) five and one-half inches in diameter. The last is the property of the Tiffany Company, and is the largest such sphere ever cut and polished in this country. In this section was displayed, also, a machine which promises to be of use outside the lines of pure science. It is a microsclerometer, invented by Dr. T. A. Jaggar, Jr., of Harvard University, and it determines with great exactness the relative hardness of minerals by means of a rotating diamond point. The number of revolutions required to cut a hole to a given depth in any substance is accurately recorded, and this gives a very direct measure of the hardness of the material worked upon.

The geological section also contained exhibits of economic as well as scientific interest. One such series was a lot of European clays and kaolins collected by Dr. Heinrich Ries, of this city, and exhibited by him for comparison with American clays. During the past winter Prof. F. D. Adams, of McGill University, Montreal, has been studying the behavior of marble when subjected to enormous pressure in a confined space. He placed a cylinder of Carrara marble in an iron tube which it fitted exactly and then he brought to bear upon it a pressure of 60,000 pounds to the square inch, with the result that the rock was compressed, but did not lose its cohesion, and the microscopic thin section showed that flowage and rearrangement of the particles had taken place, such as is known to have occurred in the crystalline rocks under the influence of mountain-building forces. The breaking pressure of Carrara marble under ordinary circumstances is 9,000 pounds to the square inch. Other interesting geological specimens were a suite of gold-bearing conglomerates from the so-called "banket" reefs near Johannesburg, South Africa, belonging to Columbia University, and a large piece of the "fulgurite" from the summit of Little Ararat, Russian Armenia, belonging to the Natural History Museum. Fulgurite is the name applied to the glass-lined holes which are formed when lightning strikes some rocks, melting the material along its path. The rock itself in this case is a lava. Mention must not be omitted of the zoological section, which contained several very interesting exhibits, the most popular of which by far was that shown by H. E. Crampton, Jr., of New York, who has been making many curious experiments upon moths, producing monstrosities and anomalies by grafting the cocoons of the same or different species together. At the reception he displayed many examples of grafted cocoons and the insects hatched from them. One "tandem" moth was hatched during the first night of the reception and there were two other living compounds to be seen under glasses, besides many which had been preserved in alcohol or other fluid. Moths with two bodies and no head, those with two sets of wings, those with the body of one growing out of the back of another, and those with two sets of antennæ were some of the curiosities on exhibition. An ingenious contrivance in the section devoted to experimental psychology registered upon paper the effect produced on the nervous system by various mental emotions, such as those of pleasure or pain. This machine was devised and exhibited by W. L. McWhood, of Columbia University.

The sections into which the exhibition was divided and those who had charge of them were as follows:

Anatomy, George S. Huntington and Jos. A. Blake; Astronomy, J. K. Rees, Harold Jacoby and H. S. Davis; Botany, George V. Nash; Chemistry, Charles A. Doremus; Electricity, George F. Sever; Ethnology and Archæology, Franz Boas and L. Farrand; Experimental Psychology, Charles B. Bliss; Geology, Arthur Hollick; Mineralogy, Edm. O. Hovey; Paleontology, Gilbert Van Ingen; Photography, Cornelius Van Brunt; Physics, William Hallock; Physiography, R. H. Cornish; Zoology, E. B. Wilson; Philology, Lawrence A. McLouth and A. V. Williams Jackson.

PRESERVING PLANT COLORS.

A. F. Woods describes a method of preserving the green color of plants for exhibition purposes which appears to be similar in principle to the coppering of green pease. Air is removed as completely as possible from the surface and intercellular spaces of the plants by immersion in 90 to 95 per cent alcohol, or an air-pump may be employed. The plants are next immersed in dilute glycerin (5 per cent) to which a bluish tint has been imparted by means of copper sulphate or acetate. The copper combines with the chlorophyl, forming copper phyllocyanate, which is practically insoluble in any ordinary preservative medium except strong alcohol, and is not affected by light. Any access of copper salt may be dissolved out by a mixture of dilute glycerin and formalin, which may also be employed with advantage as the preservative medium.—Botanical Gazette, xxiv., 206.

THE HEAVENS IN MAY.

BY GARRETT P. SERVISS.

In the evenings of May the Milky Way occupies a very peculiar position. Instead of crossing the dome of the heavens, the "starry baldrick" lies along the northern horizon, stretching from the west to the east point, and visible only where there are no buildings or lofty hills to intercept the view. From the eye of the ordinary observer it has completely hidden itself, but those who know how to look can see it running, like the last delicate glow of twilight, around half the circle of the sky.

In its center, just under the pole, at 9 P. M., in the middle of May, almost touching the hills in our northern latitudes, and dipping under them in the southern, hangs Cassiopeia's chair. Toward the west from Cassiopeia appear Perseus and Auriga setting, and toward the east the Northern Cross and Lyra rising. Overhead are the Great Dipper and Coma Berenices, while Virgo is on the meridian in the south, and the quadrangle of Corvus is just to the west of it. In the southeast the fiery Scorpio is lifting himself with sprawling claws from the horizon.

THE PLANETS.

Jupiter, in Virgo, crossing the meridian at a commanding elevation soon after 9 o'clock in the first part of the month, is a splendid phenomenon, the delight of all possessors of small telescopes. The first view of Jupiter with a telescope is a memorable experience for any one who has knowledge and imagination sufficient to appreciate it. The increasing clearness of the air, the agreeable temperature, and the convenient situation of the great planet all combine to make amateur observations of Jupiter especially attractive this month.

On the 9th, at 8:08 P. M., Jupiter's first satellite will begin to transit the planet's disk. At 9:04 P. M. the shadow of the same satellite will appear on the disk. At 10:23 P. M. the satellite will pass off the disk, and the shadow will follow it off at 11:20.

On the 10th, at 8 o'clock, 26 minutes, 32 seconds, the first satellite will reappear from eclipse in Jupiter's shadow. The reappearance of one of Jupiter's satellites after an eclipse is always an interesting phenomenon. The eye is startled as if a new star had instantaneously sprung into being out of black space. In watching for the reappearance on this occasion, keep the attention fixed on the sky, close to Jupiter, on the side from which the planet appears to be moving when allowed to drift across the telescopic field. The time given is Eastern standard.

On the 16th both the disappearance and reappearance may be witnessed in an eclipse of Satellite III. The disappearance will occur at 8 o'clock, 43 m. 48 s. and the reappearance at 11 o'clock, 11 m. 35 s. On the same evening the transit of Satellite I. and its shadow may be watched, the transit of the shadow, which, for small telescopes, is the most interesting part of the phenomenon, beginning at 10:59 P. M.

Mercury, which was conspicuous with Venus in the evening skies of the middle of April, comes into conjunction with the sun on May 1, and after that becomes a morning star. It remains throughout May in the constellation Aries.

Venus is nightly growing more beautiful in the west after sunset. Toward the close of the month it will not set until after 9 o'clock. It moves from Taurus into Gemini, crossing the Milky Way. It will be in conjunction with Neptune early on the morning of the 19th.

Mars, remaining throughout May in Pisces, is a morning star, rising about 3:30 o'clock at the beginning of the month and about an hour earlier at the end. It is inconspicuous.

Saturn rises about a quarter after 9 in the evening on the 1st of May and soon after 7 o'clock at the close. It is on the borders of Scorpio and Ophiuchus, and its rings are beautifully opened for observation.

Uranus is in Scorpio, a few degrees west of Saturn, and close to a pair of little stars, the Omegas.

Neptune is on the horns of Taurus, setting early in the evening.

THE MOON.

May opens with the moon approaching the full, a phase that is reached early in the morning of the 6th. Last quarter occurs on the afternoon of the 12th, new moon on the morning of the 20th, and first quarter at noon on the 28th.

The moon is nearest the earth on the 7th and farthest on the 23d. Its greatest eastern libration occurs on the evening of the 1st and western on the morning of the 14th.

The lunar planetary conjunctions occur as follows: May 3d, Jupiter; 7th, Uranus; 7th, Saturn; 16th, Mars; 18th, Mercury; 22d, Neptune; 22d, Venus. On this occasion Venus will be less than one degree south of the moon, a little before 1 o'clock P. M.

On May 6th occurs a meteoric shower having its radiating point in the constellation Aquarius, the center of which rises about 1 o'clock in the morning.

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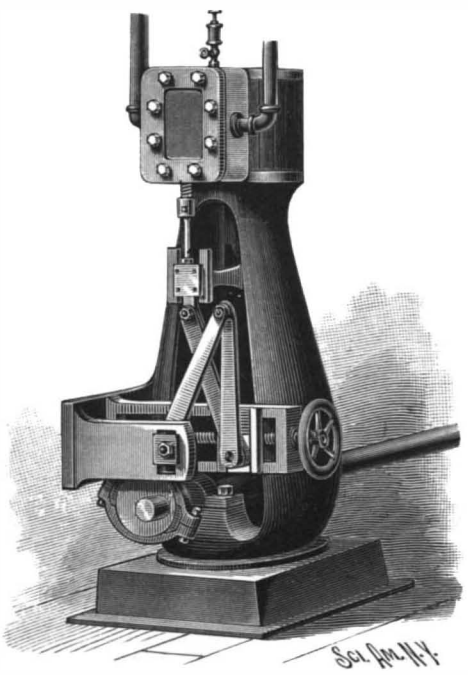
A SIMPLE AND EFFECTIVE VALVE GEAR.

The illustration represents a valve gear more especially designed to transmit motion to the valves of reversing steam engines and other engines and machines. It has been patented by William Lowe, a mechanical engineer, of No. 49 Cambridge Street, Paddington, Sydney, New South Wales, Australia. The valve stem of the usual slide valve is pivotally connected with a pin held in the forked end of a link pivotally connected at its lower end with a pin in a block which slides in a vertical guideway, this guideway sliding in a horizontal

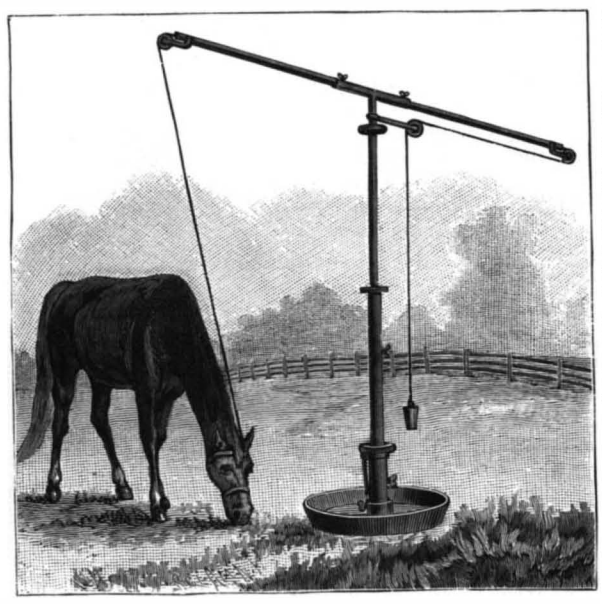


LOWE'S VALVE GEAR.

bearing attached to a stationary part of the engine. By means of a screw having a hand wheel the guideway is movable to either side of the main driving shaft, according to the direction in which the engine is to run. On the pin with which is pivotally connected the link leading to the valve stem is fulcrumed another link, which is pivotally connected at its upper end with the free end of the rod of an eccentric on the main driving shaft, the rod having near its strap a pin which engages a block sliding in a vertical guideway. The two vertical guideways stand parallel, and the eccentric strap is preferably provided with movable side pieces for taking up wear. This valve gear has been found to be accurate in its action, having equal lead, and the steam ports opening an equal distance when the reversing screw or lever is in any position between the lead and a full open port.

A TETHER FOR ANIMALS.

The illustration represents a tether made in adjustable sections, designed to contribute to the comfort of an animal feeding, while affording great freedom of movement within prescribed bounds, the movement of the animal in any direction being without danger of entanglement in the tether rope. The improvement has been patented by John Day, of Logansport, Ind.



DAY'S TETHER.

The base section of the standard has a lower pointed end on which is a spiral thread, to facilitate firmly anchoring it in the ground, this section passing through a flanged opening in the center of a pan which may be used as a trough for water or feed, the pan being adjustable in position and held in place by a set-screw. The base section is adapted to receive a second section, and the latter a third section, both held in place by set-screws, and in the top of the upper section is introduced a tubular T-head having a flange on its vertical member, adapting it to turn freely on the top of the standard. A tubular crossarm is held by set-screws in the horizontal member of the tubular T-head, a pulley being held on a bracket opposite each end of the crossarm, and a bracket near the top of the standard carries another pulley, these three pulleys affording, as will be seen, a guideway for the tether rope or chain, which is attached at one end to the halter of a horse or a stall on an animal's head, a weight being secured to its other end. To facilitate forcing the lower or base portion of the standard into the ground, a ring on which is pivoted a lever with a camhead loosely encircles this section near its top, and by means of this lever the section may be turned to carry this section into or out of the ground, by means of the spiral thread on its pointed portion beneath the surface of the ground. The radius of the circle in which the animal tethered may have movement is regulated by correspondingly adjusting the position of the tubular crossarm in the horizontal member of the T-head. As the weight is designed to be just sufficient to take up the slack of the tether rope, it is evident that the animal will not be inconvenienced to any great extent in feeding.

Pure Water for Troops on Active Service.

Now that there seems to be a likelihood of our soldiers engaging in warfare, and in a country too notoriously unhealthy for unacclimatized white men, every regard to the sanitary arrangements of the army should be carefully looked into, and especially so far as a pure water supply is concerned. The prevalence of fever, and the amount of field service performed by the troops, has several times been pointed out as a well-marked coincidence. The reason of this is not far to seek, but must in the large majority of cases be put down to the impurity of the water which the men on active service are compelled to drink. The danger of contracting fever from this cause might be greatly lessened by providing portable water filters for troops operating in the field. At such times the men are dependent upon surface-water supplies, and it may be said that surface-water supplies are always dangerous. Dr. Smart, in a communication to the office of the war department in July last, discussed this subject, and in the course of his remarks said: "I desire to point out that in the early days of the settlement of our Western country fevers were common, both in military commands and in civilian communities. These fevers were of an adynamic type. By some observers they were regarded as malarial remittents, by others as specific typhoid fevers, while others again, among whom was myself, considered that although the majority of the cases were of malarial origin, occasional cases were due to the specific cause of enteric fever, either developed de novo or propagated from some previous cause. Notwithstanding differences of opinion as to the nature of the fevers, there was a general belief that the water supply was concerned in their causation. This belief became strengthened as continued observation showed that these fevers diminished in prevalence both at military stations and in civilian settlements as purer water supplies were obtained. The advisability of providing pure water for troops in the field may be considered evident. The possibility of making this provision seems to have been hitherto an untried experiment, at least in this country." It is impossible to gainsay the truth of these words, and at this juncture they should have special weight, for in the case of hostilities being carried into Cuba, it is more than probable that those engaged in fighting would have as much to fear from disease as from Spanish bullets. Therefore it will be judicious to take every possible precaution.—Medical Record.

Exports and Imports in March.

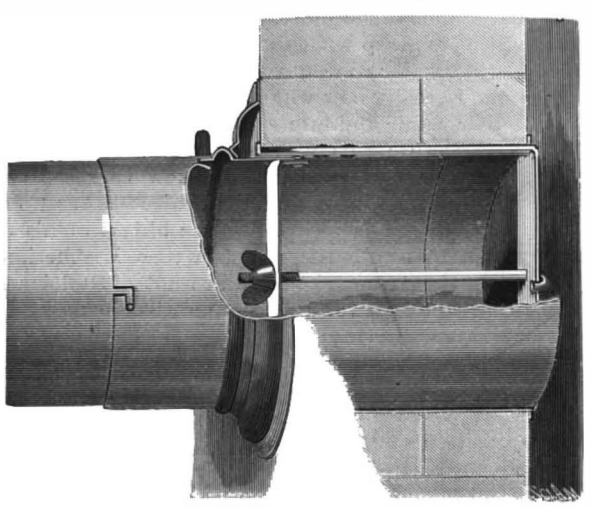
The statement of the exports and imports of the United States issued by the Bureau of Statistics shows that in March last the exports of domestic merchandise amounted to $110,944,664, an increase of nearly $25,000,000 as compared with March, 1897. The imports of merchandise in that month were $61,507,437, of which nearly $27,000,000 was free of duty. The loss in imports of merchandise was about $15,000,000. The gold exports in March amounted to $658,834, and the imports to $30,200,265. The exports of silver aggregated $3,995,818, and the imports $445,352.

For the nine months ended with March there was an increase in the exports of merchandise of nearly $104,000,000; a decrease in the imports of $43,667,298; a decrease of $2,875,808 in the exports of gold, and a decrease of $13,000,000 in the imports of gold. The exports of silver show a decrease of $4,241,167, and the imports an increase of $417,461.

To determine the effect of the vapors of melted asphalt on plant life, experiments have been made by Prof. Sorauer with various plants, shrubs, etc., by subjecting them for a few hours to the action of the vapor. No immediate injury was noticeable, but after a few days changes took place which varied with different plants. Horse chestnut trees and rose bushes showed a shrinking of the epidermis; plants rich in tannin acquired a brown color and coagulation of cell contents took place; others became white, probably from the filling of the interior with air, through breaking down of cell tissue.—Südd. Ap. Ztg.; Phar. Era.

AN EFFICIENT STOVEPIPE FASTENER.

The illustration represents a device designed to facilitate securing a stovepipe in position, and holding the pipe so that there will be no danger of soot blowing through the joints into the room. The improvement has been patented by Jerome Jones, of Kansas City, Mo., (address in care of Egelhoff Shoe Company). Upon the thimble held in the chimney wall, and opening into the flue, is riveted an approximately U-shaped metallic bar, whose middle portion extends across the inner end of the thimble, and forms a support for the hook of a screw rod whose other end is engaged by a cross piece secured to the inside of a short pipe section loosely fitting in the thimble and projecting outwardly to receive the end of the stovepipe. The inward movement of the short section is limited by a bead which abuts against the inner edge of a ring-shaped cover

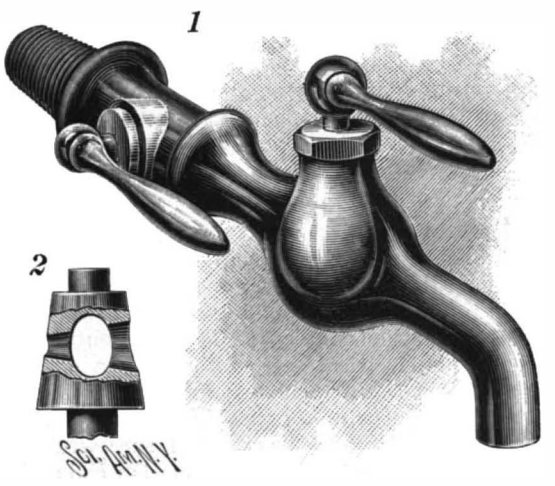


JONES' STOVEPIPE FASTENER.

engaging the outer face of the chimney, thus forming a tight joint, and in the outer end of this section are bayonet slots to be engaged by short pins on the inner end of the stovepipe, there being a handle or thumbpiece on the short section by which the latter may be conveniently turned to bring the parts into engagement. When the stove is taken down, the short section and ring cover, as well as the stovepipe, are removed, and the screw-rod is utilized to hold in place an outer cover, which rests with its edge against a packing on the outer face of the chimney.

AN IMPROVED FAUCET.

A faucet which affords means for reducing the flow and force of a stream of water under pressure at the delivery end of the pipe is shown herewith, and has been patented by C. W. Brackett and S. L. Rockwell, of Jordan, N. Y. An auxiliary faucet or stop-cock is attached to the main faucet or is preferably made integral therewith, and the key of the auxiliary faucet is of novel construction, having preferably an oval opening, from one side to the other, adapted to admit of uninterrupted flow of water to the main faucet, and having also one or more auxiliary openings, as shown in the small figure, at an angle to the first named opening. The auxiliary openings are of less diameter than the main opening, and are tapering, their larger ends facing the main outer faucet. By the turning of the auxiliary faucet the pressure of the water may be reduced at the de-



BRACKETT AND ROCKWELL'S FAUCET.

livery or main faucet, so that the water will pass out in a full stream but with a gentle flow.

IMPORTANT experiments dealing with a plague of locusts are reported from South Africa. Mr. Edington, director of the Bacteriological Institute of the Cape Town government, has succeeded in destroying millions of insects by inoculating a few and turning them loose. He makes a sort of toxin by grinding up the bodies of locusts which have perished of disease. The resulting powder is mixed with water and smeared over the bodies of a few hundred locusts which are released. The disease soon spreads and the swarm all perishes.

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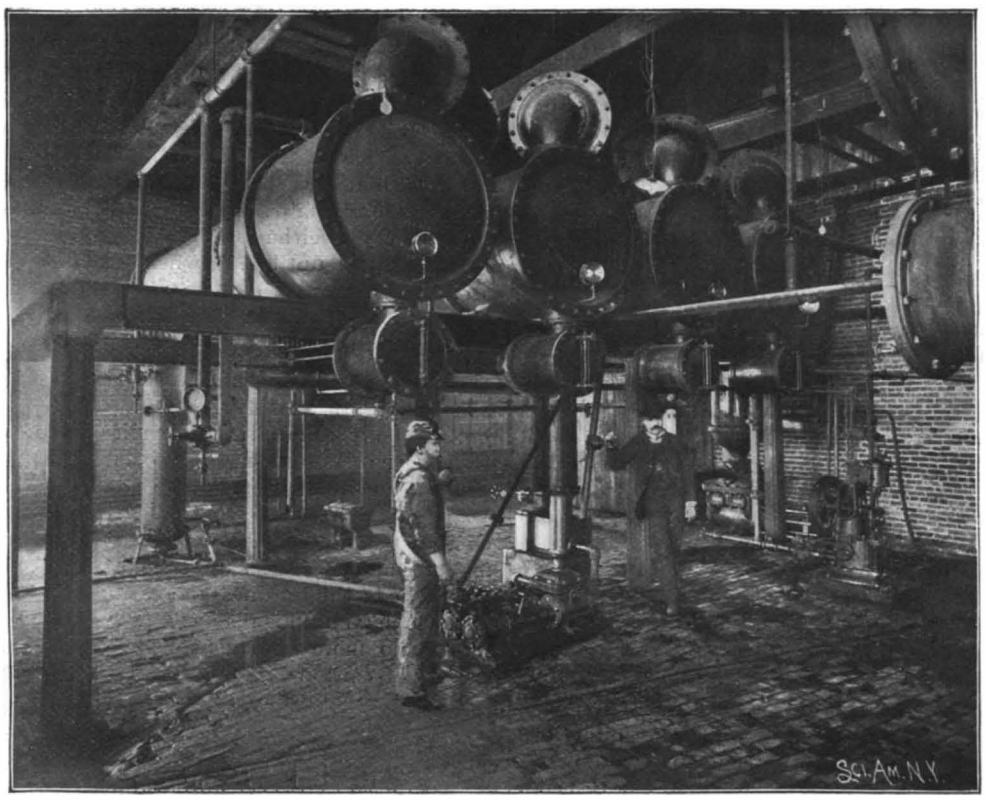

Fig. 4.—TRIPLE EFFECT YARYAN EVAPORATORS FOR CONCENTRATING SPENT ALKALI LIQUOR.

THE MANUFACTURE OF PAPER.

(Continued from first page.)

the digesters, the covers being removed for this purpose.

The cooking liquor is prepared by dissolving soda ash until the requisite strength is secured and then treating the same with lime in what are known as the causticizing tanks, where the liquor is rendered caustic. As soon as the precipitated carbonate of lime has settled to the bottom of the tanks the liquor is pumped out for use in the digesters. In charging a digester, it is first filled with the poplar chips and then the proper amount of liquor is run in. The manhole cover is swung into place and securely bolted down. Steam is then admitted through an injecting device in the bottom of the digester, and, under its action, the temperature rises and a thorough circulation of the liquor through the chips is secured. During the cooking, which lasts for nine hours, the pressure rises to 110 pounds to the square inch, this being accompanied by a corresponding rise in temperature. As soon as the cooking is completed the contents are blown out at 110 pounds pressure into an iron blow-pit through a pipe leading from the bottom of the digester. Blowing off at this pressure serves, first, to thoroughly empty the digester, and, secondly, to blow the fibers apart, rendering the pulp easier to wash, etc., in the subsequent steps of its preparation.

From this blow-pit the pulp goes through a series of washing pits, from which the spent liquor drains off through perforated bottoms and is stored for treatment by the "recovery process," as described later in the present article. The fiber is then subjected to washing in a series of weak, spent, alkali liquors, and finally it is thoroughly washed with hot water. When first discharged from the digesters the pulp was black in color; after its last washing, it is a pale buff.

The pulp is now mixed with sufficient water to render it sufficiently fluid to be piped onto the screens or strainers. These remove any uncooked portions of the wood that may be in the pulp. This latter, in these modern days of the art, is very trifling in amount, as the process completely reduces the poplar, even to the knots. From the screens the pulp is run over a "wet press," where the surplus water is taken out. It is now carried by a conveyor to the bleaching engines, in which it is thoroughly bleached with ordinary chloride of lime. The screening and bleaching are carried out in a similar plant to that used in the preparation of sulphite pulp, an illustrated description of which was given in our paper describing the sulphite process, and to this the reader is referred.

At the present time the pulp mills of the Duncan Company manufacture a larger amount of pulp than their paper mills can take care of, though the latter are soon to be enlarged to the pulp mill capacity. At present the surplus is sold to other paper mills which have no facilities for manufacturing their own fiber. In each twenty-four hours 14 tons of sulphite fiber and 20 tons of soda fiber are placed on the market. The sulphite pulp is shipped wet and unbleached, but the soda pulp is always bleached and dried before shipment.

For convenience of shipment and handling, the sulphite pulp destined for the market is run into sheets in a special machine known as a "wet press," of which we present an illustration on our front page (see Fig. 3). Instead of passing from the screens to the bleaching engines, it is piped into a tank in which is a rotating cylinder, about 2½ feet in diameter and 4 feet long, whose shell is formed of fine wire cloth. The cylinder (see Fig. 3) is immersed in the pulp until only about 2 inches of it appears above the surface. One end of the cylinder is open and turns in close contact with a fixed board (which is broken away in the illustration to show the interior of the cylinder). At the bottom of the closing end board is a square opening through which the waste water flows away from the interior of the cylinder. It will thus be seen that the tank is divided vertically into two compartments, in one of which is the drum, the other forming an outlet chamber for the waste water.

The pulp, which has something of the appearance of thin milk, flows into the tank and surrounds the drum. The wire cloth periphery of the drum allows the pulp water (that is, the water minus the fiber) to flow through the wire and enter the interior of the drum, the fiber being restrained from passing through by the sieve-like action of the wire cloth. As the drum rotates from right to left, the pulp is carried up on the wire surface and the water drains away from it, falling through the wire to the inside of the drum, where it passes away through the side board, as already explained. Above the drum and resting upon it is another drum, over which travels an endless band of rough felt. The layer of pulp is carried round on the wire and pressed against and "picked up" by the felt, to which it adheres, leaving the drum. The drum is cleaned by the action of strong jets of water which wash the wire cloth as it passes down in front of them. The sheet of wet pulp is carried on the felt over the top roller of the machine and passes down between two rolls which are drawn together by screw pressure. The sheet of pulp wraps around the upper and larger of these rolls until there are several thicknesses, the pressure squeezing out the surplus water and serving to "form up" the pulp into a sheet looking something like a piece of rough millboard. As soon as the desired number of layers has been wrapped on the roller they are cut off by the workman, shown in the engraving, and placed on the pile at his elbow ready for shipment.

In our engraving (Fig. 6) the upturned edge of the sheet of pulp shows clearly the various layers of pulp that give the thickness to the sheet. Below the sheet

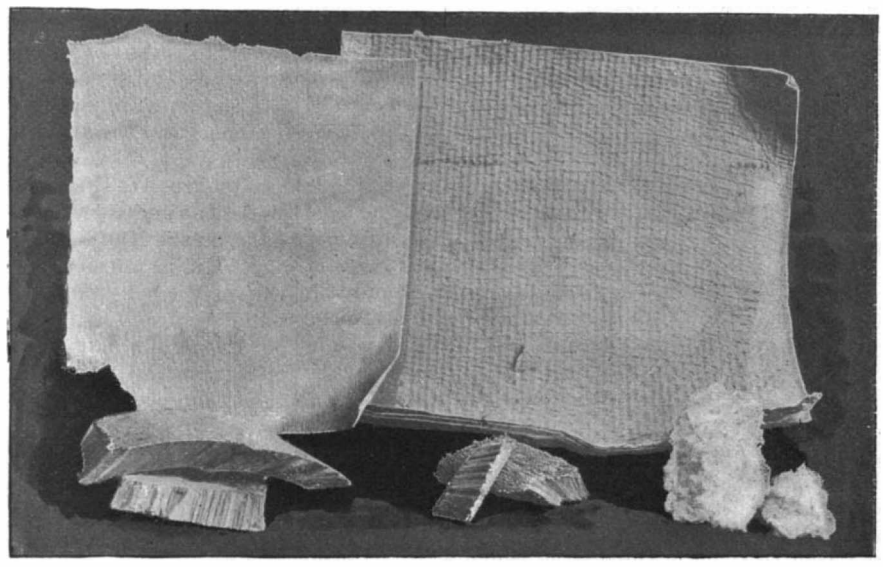

Fig. 6.—POPLAR CHIPS AND A SPRUCE CHIPS, A LUMP OF PULP, AND A SHEET OF BLEACHED SODA PULP. A SHEET OF UNBLEACHED SULPHITE PULP.

in the same engraving are shown some spruce chips as they come from the chipper before they are cooked in the digester. The white mass to the right of the chips is a lump of pulp which has been bleached and washed and is ready to go to the paper mill.

The soda pulp for the market is taken from the bleaching engines and run into the sheet form over a drying machine, where it is dried out by passing over a series of large cylinders filled with live steam, being finally wound into large rolls for shipment. A small sheet of this pulp is shown in the engraving with some poplar chips in front of it. The difference in grain between the poplar and spruce and the difference in texture between the two sheets of pulp is clearly discernible.

One of the most interesting features of the soda mill is the recovery process, by which the valuable constituents of the spent alkali liquor are recovered and used in the preparation of the caustic soda. The spent liquor is conveyed to the Yaryan evaporators (Fig. 4), where it passes through a coil of pipes contained in a steam-tight shell. A small amount of steam is introduced within the shell, the heat of which causes the spent liquor within the coil to evaporate. The liquor and the vapor, which has separated from it during the evaporation, now enter the enlarged head (see Fig. 4), where the liquor falls to the bottom and passes to a similar system of coils in the "second effect," while its steam rises and passes into the shell of the second effect. Here the steam condenses on the coils, giving up its heat and causing a further evaporation of the liquor. This is repeated in the third effect, and the final concentrated liquor is drawn off by a pump. The final vapors of evaporation are removed through a condenser by means of a vacuum pump. To show how much work of evaporation is done on the liquor during

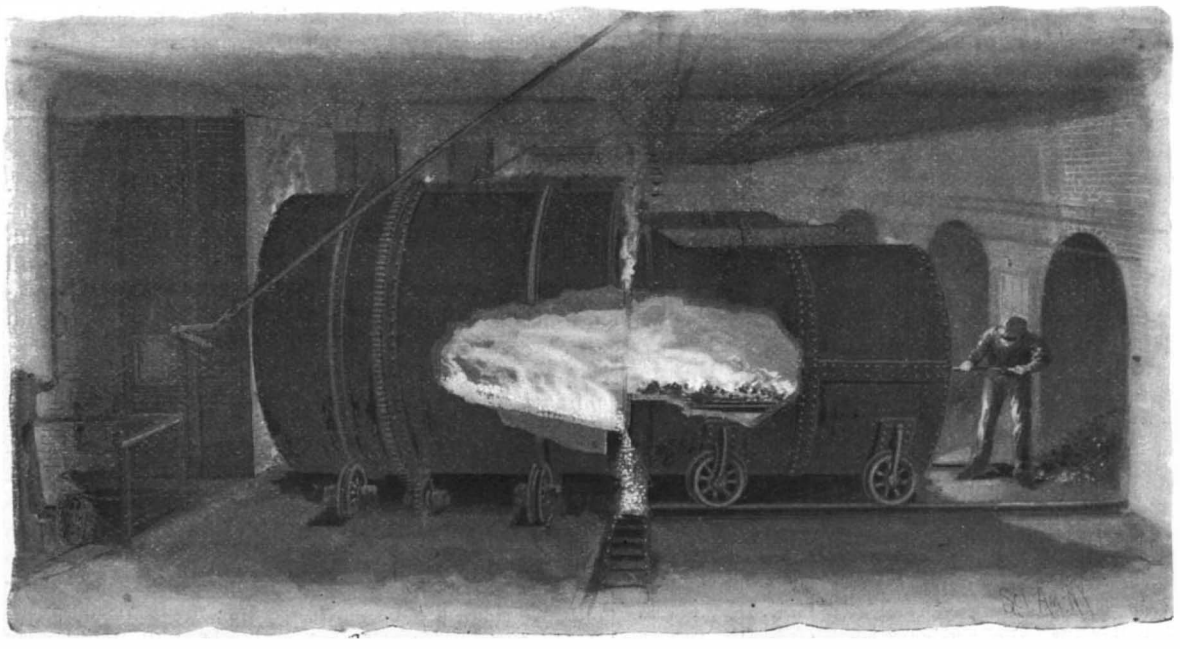

Fig. 5.—ROTARY RECLAIMING FURNACE FOR THE RECOVERY OF BLACK ASH FROM SPENT ALKALI LIQUOR.

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its transit through the series, it may be mentioned that fully 90 per cent of the total water in the spent liquor has been removed.

The concentrated liquid now passes to the rotary reclaiming furnaces (Fig. 5). These consist of large steel cylinders, lined with fire brick and open at the ends. At the front and larger end is a movable fire box in which a comparatively small coal fire is kept burning. At the rear the furnace gases serve to heat a set of boilers whose steam supplies the Yaryam evaporators. The remaining moisture in the concentrated liquor is quickly evaporated in the rotary furnace, and the resinous and organic matter takes fire. The interior of the furnace is funnel-shaped and, as it rotates, the black ash rolls forward, and falls continuously into a horizontal conveyor, traveling at the floor level. The recovered black ash, which contains 50 per cent of sodium oxide, 15 per cent of unconsumed carbon and 1 per cent of mineral impurity from the wood, is carried by the conveyor to large leaching pans in which the alkali is leached out. The leach liquor is next conveyed to the causticizing tanks (Fig. 2), where lime is added and thoroughly mixed by means of agitators. The cycle of operations is now complete and the liquor is ready for the digesters.

Up to ten years ago, soda was recovered by a series of open evaporating pans in which, when the spent liquor had evaporated to a certain consistency, it was worked by hand, after the manner of puddling in an iron mill.

In those days, the cost of recovery was from 40 to 50 cents per 100 pounds; to-day it is only 5 or 6 cents per 100 pounds. It is owing largely to this improved process that the present low price of book papers is possible.

Essex County Parks.

Essex County, New Jersey, includes within its territory the city of Newark, the Oranges, Montclair, and other New Jersey towns, and this charming section of the State of New Jersey is to have one of the most beautiful and extensive systems of parks in the country. Certain sections of the county were found to be admirably suited for park reservations, and two such tracts of land, one of 1,600 acres and one of 400 acres, have already been secured in the southwestern and western extremities of the county. These are rare stretches of rocky and wooded hills, fields and valleys with beautiful still and running water. From Eagle Rock on the crest of the hill back of Montclair can be seen the homes and working places of a greater number of the people than can be seen from any other point in the world, the eye ranging for miles over hills and valleys, with here and there a dwelling house. To the westward are the unbroken woods, which make a wonderful contrast to the view from Eagle Rock. In the southeast corner of the county, 200 acres of land including a small pond has been secured. Little work will be done on these reservations except to preserve and protect their natural features and to provide a few roads and paths. In contrast with these three rustic parks will be some 250 acres near the most densely populated sections of the district, which will be developed by landscape gardening. A portion of this park together with three small parks will be designed for the needs of those who cannot go to the distant reservations. Possibly the finest feature of the scheme will be the splendid parkways which are proposed to connect the various parks. These will extend to some of the more rural sections of the county, which are not in need of parks as yet, but which will be directly benefited by the parkways. One of the parkways will pass along the crest of the first range of mountains.

A Historical Celebration in Florence.

Florence is now celebrating the fifth centenary of Paola Toscanelli and Amerigo Vespucci, both of whom were Florentines. The festivities will last from April 17 to 27, and a geographical congress will be held at Florence during the fetes. Many Americans were present in the city, and they presented to the Council an American flag beautifully embroidered to commemorate the occasion. Paolo Toscanelli was a learned man to whom Columbus was greatly indebted for advice and maps of the world. Amerigo Vespucci was the friend and follower of Columbus and our name America is derived from his baptismal name. In the SCIENTIFIC AMERICAN for March 19, 1898, we have described and illustrated the remarkable portrait of Amerigo Vespucci which has recently been discovered in Florence. The festivities include the unveiling of a commemorative monument in the church of Santa Croce, the illumination of the city and surrounding heights, nocturnal fetes on the Arno, lectures and speeches, historical living pictures in the great hall of Palazzo Vecchio, a meet of bicycle clubs, a horse show in the Cascine, reproductions in historical costumes of old Italian games, a masked ball, a grand orchestral concert in the Palazzo Vecchio, and in fact nearly everything which seems calculated to attract foreigners to Florence. Those who were fortunate enough to see the Donatello celebration in 1889 can form some idea of the delightful programme.

Electrical News and Notes.

Trolley Travel in Boston.—Boston travel on the suburban steam lines in the last four years is estimated by the State Railroad Board to have decreased about 10 per cent, while the corresponding trolley travel has increased 25 per cent. It runs this way all through New England.

Electric Installations on the Pacific Slope.—During the past eight years, fifty-two distinct companies in the Rocky Mountain district alone have installed electric power machinery for mining and ore reducing purposes. The plant comprises 62 generators, aggregating 7,988 kilowatts, and 135 motors, aggregating 4,816 horse power, operating every variety of mining and milling machinery.

Long Distance Transmission Plant.—10,000 horse power will be transmitted 110 miles to San Francisco if the plans of a company, of which Prince Poniatowsky is said to be the head, are completed, says Engineering News. It is proposed to utilize the water now running to waste on the western slope of the Sierra Nevada Mountains in Alpine, Amador and Calveras Counties, constructing a system of canals and a power plant. The transmission line at one place will cross San Francisco Bay with a span about 325 feet above the water. The total cost of the plant is estimated at about $1,000,000.

Fires in Shop Windows.—In view of the numerous fires that have recently taken place in shop windows in Germany, the German police have issued a notice containing the following recommendations, says The Electrician: All glow lamps used in shop windows should be provided with globes, shades or wire guards, or so arranged that they cannot come into direct contact with inflammable material. If the lamps are surrounded with silk or other fabrics, the covering must not envelop the lamp completely, so that the air can circulate between the lamps and the covering. Arc lamps should be provided with ash trays of metal instead of the glass ones usually employed. Conducting wires in the windows should be well insulated.

Electric Lighting of the Pyramids.—Lighting the pyramids of Egypt with electricity and the installation of a 25,000 horse power plant, to cost some $400.000, is a plan now under consideration by the British government, and the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa., are reported as likely to receive the contract. As outlined, the plan includes the generation of electric power at the Assouan Falls, on the Nile River, and its transmission a distance of 100 miles through the cotton growing districts, where, it is believed, the cheap power will permit the building of cotton factories. It is planned to use the power to illuminate the interior corridors of the pyramids and also operate pumping machinery for irrigating large areas of desert along the Nile.

Magnetic Study of Iron.—It has long been known by physicists that iron alters in length when magnetized. This phenomenon is made the subject of a special study by Prof. Brackett, of Princeton, in The Physical Review, December. The author treats specially of the effects of tension and of the quality of the metal upon such changes in length in iron wires, and he describes researches made by him at the suggestion of Prof. Rowland, of Johns Hopkins University. Prof. Brackett believes that the investigation has established the following laws: "Any increase in the magnetic induction tends to lengthen the iron wire; the magnetizing field tends to shorten the wire, and the shortening due to this cause apparently has no limit; the elasticity changes with the induction; . . . but the law of the change is unknown, further than that elasticity changes only as the induction changes."

Electric Railways of Europe. — L'Industrie Electrique has just published a complete list, with details, of the electric railways now operating on the Continent of Europe and in Great Britain. The summary printed herewith shows that Germany is far ahead of any other European country in both the number of electric railways and in the length of mileage, etc. It is interesting to note also that Germany has four roads using storage batteries and France five such roads. Switzerland also makes a very good comparative showing.

	Total Length, Kilometers.	No. of Motor Cars.	Overhead Lines.	Underground Lines.	Center Rail Lines.	Lines with Accum.	Total No of Lines.
Germany	642·69	1,631	45	2	..	4	51
England	109·42	168	10	1	6	1	18
Austria - Hungary	83 89	194	7	2	..	1	10
Belgium	34·90	73	4	1	..	..	5
Bosnia	5·60	6	1	..	.	..	1
Spain	47·00	40	3	.	..	..	3
France	279·36	432	19	1	1	5	26
Holland	3·20	14	..	..	..	1	1
Ireland	18·00	32	1	..	1	..	2
Italy	115·67	289	9	..	..	..	9
Sweden - Norway	7·50	15	1	..	..	..	1
Portugal	2·80	3	1	..	..	..	1
Roumania	5·50	15	1	..	.	..	1
Russia	14·75	48	2	1	..	..	3
Servia	10·00	11	1	..	..	..	1
Switzerland	78·75	129	17	..	..	..	17
Totals	1,459·08	3,100	122	8	8	12	150

Science Notes.

William Gascoigne is credited with the first use of cross-hairs in telescopes in 1640, or a little earlier, says The Engineer. Gascoigne fell at the battle of Marston Moor in 1644. He speaks of only hair and thread. In 1662 Malvasia employed, besides hair and vegetable fiber, silver wires. In the middle of last century glass and mica plates, with engraved lines, were employed in place of cross-hairs, as described by Brander in 1772, and used by Breithaupt in 1780. Spider webs were not thought of until 1775, when their use was advocated by Fontana. In 1818 Struve employed fine glass threads, and platinum wire has been substituted in recent years.

By tempering steel containing 0·45 per cent of carbon at a temperature of 1050° Cent., a probably homogeneous body consisting of needles is obtained, says Mr. F. Osmond, which when belonging to the same group or bundle run parallel to each other, while the groups often cross each other. All other conditions remaining equal, the needles of the martensite become smaller and less distinct the closer the eutectic alloy is approached; the hardness increasing at the same time until the maximum is reached. Beyond this limit the mass is no more homogeneous. Steel containing 1·5 per cent of carbon and hardened at a temperature of 1050° Cent. separates in two bodies.

A chronograph for recording exceedingly small intervals of time, such as a millionth of a second or less, has been used to record autographically the compression by a blow of a cylindrical piece of copper. In one case a thirty-three pound weight fell fifteen inches and produced a permanent compression of 0·1658 inch in a copper cylinder, the time consumed in producing the compression being 0·0030317 of a second. The machine produces by photography a curve showing the progress of the compression. The chronograph consists of a rotating cylinder, with a surface velocity of 100 feet per second, on which is photographed a pencil of light, which is passed through a hole in the end of a rapidly vibrating tuning fork. The delicacy of this instrument is far greater than that of the ordinary tuning fork chronograph, in which the record is made on a surface blackened by smoke.

A New Solvent for Nitrated Cellulose.—Dr. H. Fleming is employing, as a solvent for nitrated cellulose, epichlorhydrin and dichlorhydrin. The first (CH_2 $OCH + CH_2$ Cl) is insoluble in water, but freely soluble in alcohol and ether, boils at + 117° C., and has a specific gravity of 1·203 at 0° C. The last—really the A— bichlorhydrin (CH_2 Cl CH (HO) CH_2 Cl)—is slightly soluble in water but freely soluble in alcohol and ether, boils at +174° C. and has at 19° C a specific gravity of 1·367. Epichlorhydrin will dissolve any quantity of pyroxylin, but at 20 per cent the solution assumes a very opaque appearance. For these solvents the advantage of a relatively high boiling point and low evaporation is claimed as compared with the more generally used alcohol, ether, acetone and amylacetate, but it is premature to speculate as to its possible uses in the manufacture of smokeless powders.—Arms and Explosives.

M. Camille Matignon, in a paper presented to the Paris Academy of Sciences recently, says that sodium carbide is obtained in the form of a white powder; its density at 15 degrees is 1·575, and it appears to be quite insoluble. Dry air and oxygen have no effect on it at ordinary temperatures, but, on gently heating, combustion takes place, leaving a residue of CO_2Na_2. In the presence of chlorine gas it becomes incandescent, and with bromine the reaction is of almost explosive violence. Iodine has a more moderate action, and C_2I_4, melting at 185 degrees, can be obtained. Hydrogen has no action at all. When thrown into water, carbide of sodium explodes violently, giving a deposit of carbon. It also becomes incandescent when in contact with CO_2 and SO_2. It acts in the cold on a large number of organic substances. The primary and secondary alcohols give off acetylene, giving rise at the same time to the corresponding alcoholate.

The tracing of the pretty curves formed by compounding pendulum vibrations of different periods is a fascinating pastime of which we were beginning to believe the resources were pretty well exhausted. Prof. Charles Schlichter, of Winconsin, has, however, discovered "fresh woods and pastures new" by extending the method to space of three dimensions, and representing, by the aid of the stereoscope, the resultant of harmonic motions of three frequencies in three different directions, mutually at right angles. To do this, says Nature, Prof. Schlichter attaches a miniature electric lamp to the bob of a Blackburn pendulum vibrating in a horizontal plane, and photographs the tiny speck of light by means of a stereoscopic camera attached to a pendulum which swings in a vertical plane about a horizontal axis through the optical centers of the lenses. This last pendulum gives the third vibration component. When the diagrams are viewed through the stereoscope, the curves spring out into relief like bent wires, their forms for many of the higher ratios, such as 5:6:9 or 5:8:9, being very striking.

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Miscellaneous Notes and Receipts.

To Raise the Pile of Velvet.—A good method to raise damaged and pinched pile up again is as follows: Cover a hot iron with a wet cloth, lay the velvet or plush over it and beat carefully with a clothes brush. Lay the stuff on a smooth place and do not touch until it is quite dry.—Leipziger Färber Zeitung.

Lime Water for Disinfection.—A very cheap and easily prepared disinfectant is lime water. If wash is laid in saturated lime water, it must be left therein for 48 hours to insure a total extermination of all germs. If one desires to get the wash disinfected after 24 hours, it must be previously rinsed off in supersaturated lime water and left to remain in it for some time; then it is put in fresh lime water and left therein for 24 hours. Wool is very unfavorably changed in color and firmness by treatment with lime water, while linen and cotton are not at all affected as regards color; linen does not lose any of its firmness, cotton very little. Hence, woolen goods should not be disinfected with lime water; of course the lime water must not be very strong.—Staats Zeitung.

Production of Deep Black Writing Ink.—First prepare a clear logwood extract solution, by dissolving 200 parts best French logwood extract in 1,000 parts water, heating in the steam bath. Place the solution aside and allow to settle for about 8 days. Pour off clear from the sediment which has formed. Thin 200 parts logwood solution with 500 water, heat in the steam bath to about 90° C. and add drop by drop the following oxidation mixture prepared from 2·0 potassium bichromate, 50·0 chrome alum and 10·0 oxalic acid dissolved in 150·0 water. Maintain the temperature another half hour at 90° C., thin with water to obtain 1000 total weight, add one per cent carbolic acid and allow to settle two to three days. Express clear and fill in bottles.—Neueste Erfahrungen und Erfindungen.

German Artificial Indigo Alarms the Indian Indigo Planters.—Since the Badish Aniline and Soda Company, at Ludwigshafen on the Rhine, has placed its "pure indigo" on the market at a price which admits of competition with the natural product, the Indian indigo planters are naturally very much alarmed. It is correctly assumed in India that the process to produce artificial indigo will be quickly improved upon and cheapened, and that it will finally be possible to throw the artificial article upon the market at a cheaper price than the natural indigo can be sold at. Considering the exceedingly great value which the indigo trade is to East India, the press of that country discusses freely the new state of affairs. The Capital, a journal highly esteemed in India, admonishes the owners of indigo plantations not to lose courage, but to try their best to minimize the cost of production, it being more than likely that, if experienced chemists are engaged, the extraction of indigo from the plant may be increased, thus cheapening the product and improving its quality. Then a competitive war between the artificial and natural indigoes could well be carried on. From the same journal we learn that the value of indigo exported from Bengal is 4½ to 5¼ crores (1 crore= 10,000,000 rupees). The largest part by far of East Indian indigo goes to England; Germany receives direct 32 lakhs' worth, Austria-Hungary and France about the same each; the United States of America takes 57 lakhs' worth (1 lakh = 100,000 rupees). The average amount of the two dyestuffs of indigo contained in good Kurpah indigo is 50 to 55 percentum, in the Bengal variety 70 to 75 percentum.—Färben Zeitung.

Cotton Spinning Mills in China.—The Chinese are too much imbued with the true business instinct, says the Deutsche Wirker Zeitung, to be unmindful of the advantages derivable from the use of steam power in their factories, but the mandarins prevented such innovations, lest the revolutionary spirit might be introduced into the country at the same time. The unfortunate war with Japan gave a striking proof of the fact that China would be an easy prey of her neighbors if the present system of barricading were continued much longer, and thus the mandarins have given up their resistance in many respects. Among others, several cotton spinning mills were erected in Shanghai in 1896, which will start this year with 275,000 spindles, having been equipped according to the latest systems. If the experiment proves successful, which scarcely admits of any doubt, considering the low wages and the great adroitness of the workmen, many more factories will spring up. It need not be apprehended that they will send their calicoes and other ready goods to Europe, etc., thus becoming competitors; but, nevertheless, their influence will be felt, in that they will claim the Chinese market for themselves and crowd out the English now holding the market. The latter will be compelled to seek substitution somewhere else, which will most likely cause a sharper competition with Germany, etc.; also, as regards the raw material, the new spinning factories will exercise an influence. They will first take the raw cotton from China and then from the neighboring India, and the popular Indian cotton will in consequence become scarcer and dearer. At present the import of cotton goods into China is very considerable, and in 1895 represented a value of 53,000,000, in 1896 79,000,000 Haikwan tael (a tael is about 85 cents), the total value of all imported goods being 171,000,000 and 202,000,000 Haikwan tael respectively.

Transplantation of Muscles in the Treatment of Deformities.

The ingenious method of remedying loss of power and deformity from paralysis of certain muscles by attaching their tendons to those of others is of recent growth. In The Boston Medical and Surgical Journal of November 11, 1897, Dr. Joel E. Goldhurst describes an important advance on this method made by American surgeons in the last few years—the dissection out of the muscles and their direct reattachment to others. In a large number of cases of infantile paralysis the sartorius escapes. Being a flexor of the knee, its action is useless or harmful when extension is lost from paralysis of the quadriceps. To improve the limb and restore extension Dr. Goldhurst transplants the sartorius and attaches it to the quadriceps tendon just above the patella. He has operated on five patients with marked improvement in three and failure in two, which he attributes to imperfect methods of attaching the muscle. He operates as follows. A six-inch longitudinal incision is made on the inner side of the thigh with the middle opposite the top of the patella. The sartorius is dissected out, cut off at its insertion, brought forward and attached to the muscular fascia just above and a little to the inner side of the patella. The attachment must be made firmly by splitting the fascia and drawing the muscle through, so that it becomes adherent to both inner and outer surfaces. Kangaroo tendon is used for sutures, being the best material. The wound is then closed and the whole thigh is bandaged, and finally a plaster of Paris bandage or a long splint is applied. The patient is kept recumbent for two weeks at least, gentle motion is commenced at the end of three weeks, and the plaster is entirely omitted at the end of from five to six weeks. One case was that of a woman, aged twenty-two years, paralyzed from early childhood, who had no power of extension or of bearing weight on the limb unless the knee was fixed artificially, and who had a flail-like leg, flinging gait, and used a crutch constantly. After the operation, though still somewhat lame, chiefly from weakness of the foot and ankle, the mechanical difficulty at the knee and the gait were almost entirely corrected, the leg was extended normally, and she was able to do housework.—Lancet.

The Annual Electrical Exhibition.

The electrical exhibition, which has always been one of the most attractive spring exhibitions, will open this year on Monday, May 2, at the Madison Square Garden, and continue through the month of May. We believe one of its chief promoters is the New York Electrical Society, and arrangements will be made for several interesting experimental lectures.

Mr. Edison will exhibit a model built for him by Mr. Sigmund Bergmann, which illustrates the process he is so successfully using in separating iron from ore. This model will be kept running by a small motor, and the iron will be continuously separated from the crushed rock in full view. Samples of crushed rock in its various stages, as well as samples of the separated ore and of the briquettes which are sent to the furnace, will be exhibited. There will be also some four or five ton masses of rock, which Mr. Edison takes bodily out of the hillside by means of huge excavators, and the magnetic condition of these ponderous masses will be shown and tested by magnets. Photographs of the various parts of the works will be shown, so that the whole will constitute one of the most instructive demonstrations possible. This valuable exhibit will be placed along one side of the concert hall at the Garden, in company with a number of very interesting special features which have already been arranged for.

The Reindeer Expedition a Failure.

The failure of the Alaskan reindeer expedition was announced to the war department on April 18, 1898, in a telegram from Brigadier-General Merriam, commanding the military department of the Columbia. This telegram summarizes the report from Dr. Sheldon Jackson, from Dyea, to the effect that the reindeer are a failure in Alaska for want of proper forage and useless for an exploring expedition there, and many of those sent there are already dead, but enough moss has been found, so that part of the herd may be saved. The time lost will compel reorganization of exploring party No. 1, if it is to go on, but on the advice of Captain Ray and his own judgment, Dr. Jackson recommends the recall of the expedition. Acting on the recommendation of General Merriam, an order was issued at the war department on April 18, relieving Captain Brainerd, who had command of expedition No. 1, from further duty with the expedition in Alaska and directing him to report in person to the Commissary-General of Subsistence at Washington.

Correspondence.

The Classification of Warships.

To the Editor of the SCIENTIFIC AMERICAN:

I suggest that you prepare and print an article showing the utility, efficiency, etc., of the various types of war vessels, viewed from a technical standpoint. I venture to say that a large majority of the readers of the SCIENTIFIC AMERICAN would appreciate some information of this character regarding the general definitions of such words as "first-class battleship," "armored cruisers," "unarmored cruisers," "torpedo boats," "torpedo boat destroyers," etc.

To illustrate the maze which newspaper articles, and even articles in the SCIENTIFIC AMERICAN, have produced, I propound the following problems:

1. If a cruiser carries as heavy guns as a first-class battleship, what advantage is there in building such a ponderously armored vessel as the latter, as our modern rifles pierce any armor used on a battleship?

2. If a battleship carries as many torpedo tubes as a torpedo boat, why build torpedo boats, as the unerring aim of our modern guns makes it just as easy to hit as a battleship, which is armored?

3. If a torpedo boat is a strong vessel, and a torpedo boat destroyer is a stronger one, then why build torpedo boats? etc.

Judging from current information on this subject, the whole science is a huge conglomeration of inconsistencies. This can't be. J. B. BRIGHAM.

Erin, Tenn., April 18, 1898.

[In the SCIENTIFIC AMERICAN SPECIAL NAVY SUPPLEMENT, notice of which has already been announced, will be found a lengthy article of the kind asked for by our correspondent. It is accompanied by four diagrams which show the principal types of warships, and the text answers very completely the questions asked by Mr. Brigham. This article is inserted at the commencement of the number with a view to furnishing the reader with sufficient knowledge of the classification and characteristics of the various types to make the descriptions of the individual ships that fill the forty pages of the issue thoroughly intelligible.

Replying to our correspondent's questions:

1. The efficiency of a warship is determined by the possession of the double qualities of attack and defense. A cruiser does not, except in rare cases, carry as heavy guns as a battleship, and then she only carries one or two of them, as in the case of the Spanish "Viscaya." These guns give her the ability to attack a battleship, but they provide practically no defense. Complete belt and barbette armor alone can do this, and for want of it in a duel the battleship would sink the cruiser long before the cruiser could get in a vital shot through the 18-inch armor of the former.

2. The torpedo boat is built for the sole purpose of carrying and firing torpedoes; in the battleship the torpedo, like the ram, is merely an auxiliary weapon, to be used if the ship should come within close range (500 yards or less) of the enemy. Fifteen hundred to two thousand yards will be the probable fighting range of modern fleets. Theoretically the torpedo boat is not supposed to attack by day. It is supposed to operate by night or in thick weather. Invisibility and swift movement are essential to a successful attack; hence the torpedo boat is made small and swift. It is supposed to creep up as close to a fleet as possible without detection, and then when the searchlight reveals its whereabouts it will make a dash at full speed through a hail of rapid-fire shells and machine-gun bullets. Its small size and high speed render it a difficult object to see and hit.

3. The destroyer is larger than the torpedo boat and more liable to be detected and sunk by shell-fire. Many experts consider that we are going too far in building destroyers of 400 tons, as the valuable quality of invisibility is thereby lost.—ED.]

The New York Public Library.

It is stated in the Bulletin of the New York Public Library that the total number of periodicals and transactions of societies to which the library is subscribing, for the year 1898, is 2,502. Of these 483 are American, 497 British, 595 French, 660 German, 125 Italian, 36 Scandinavian, 27 Belgian, 16 Dutch and 12 Russian. During the calendar year ending December 31, 1897, the total number of volumes received by purchase was 16,098, and by gift 10,128, making a total of 26,226. The total number of volumes catalogued and accessioned during the same period was 29,792. The number of pamphlets actually received during the year, by purchase, was 10,350; by gift, 40,247; and the total number catalogued and accessioned was 15,274. The total number of cards written during the year was 156,925. In addition to this, 15,404 slips from the printer were written, and for each of these slips five printed cards were obtained. The total number of cards in the index catalogue, which was open to readers, on the 31st of December, 1897, at the Astor Branch was about 80,000, at the Lenox Branch it was 27,800. The total number of readers during the year was 103,384, and the number of volumes called for by readers' slips, outside of those taken from the free reference shelves, was 304,466.

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THE DASHIELL BREECH MECHANISM.

The breech-closing mechanism used for guns of the main battery type in the United States navy is universally constructed on the interrupted or slotted screw pattern. In the rear of the gun, back of the powder chamber, is a chamber a few inches long and of slightly larger diameter than the former. This is threaded internally. It is termed the screw-box. Three or more equal portions of the thread are cut away. In the gun illustrated there are four such divisions. A cylindrical breech plug is threaded externally so as to screw into the breech. Its thread is cut away to correspond with the slotting in the screw box. It is now obvious that such a plug could by direct translation be pushed nearly home, and that a turn of 45 degrees would screw it into place.

The distinctive breech mechanism includes far more than this, as the block has to be manipulated. In the smaller guns a rapid opening and closing breech mechanism is employed. We illustrate the Dashiell mechanism as applied to a 4-inch breech-loading rifle. The cuts show the slotted thread on the breech block and in the screw box. To the left of the gun is seen the rising and depressing rack, and beneath it are seen the recoil cylinders. The gun rests in a trunnion ring and in action slides back under the recoil some inches through the trunnion ring, and is at once drawn back to its forward position by the springs. A brass jacket is screwed upon the portion of the gun which works back and forth through the trunnion ring, or brass bearings are provided in the trunnion ring.

A massive shelf-like piece of steel, the combined collar and tray, is hinged to the right-hand side of the breech. This is curved in shape and represents a continuation of the lower segment of the screw box when swung against the face of the breech. When in this position the breech plug, which, when extracted, rests upon it, can be pressed into or withdrawn from the screw box, as the tray supports it in alignment with the axis of the gun.

To open the breech, three operations are necessary. The plug must first be rotated through a segment of a circle; in the 4-inch gun through an arc of 45 degrees. This disengages the screws from each other. Secondly, a motion of translation or of movement in the line of the bore must be given it. This is about four inches in extent in the gun described. The withdrawal leaves it on the tray. Thirdly, the tray with the plug resting upon it is swung off to the right and the breech is completely open and unobstructed. The reverse order of movements closes the breech. The series is executed by a single sweep of the handle seen extending to the left of the piece. We will assume the breech to be closed and describe the opening operations.

A series of teeth are cut on the lower part of the rear of the breech plug, forming a toothed arc. Along the bottom of the tray a horizontal groove is cut, and in this a rack bar operates, whose teeth engage the teeth on the breech plug. A second toothed arc is part of the rear prolongation of the hand lever, and engages a second set of teeth on the rack bar in the groove in the tray. When the breech is closed this hand lever is swung over to the left. When the gunner wishes to open the breech he pulls the hand lever back, which in the first portion of its swing drives the rotating rack to the left, thereby rotating the breech plug through a 45 degrees angle. When the proper travel is accomplished the end of the rotating rack brings up against a stop and the plug can be rotated no more.

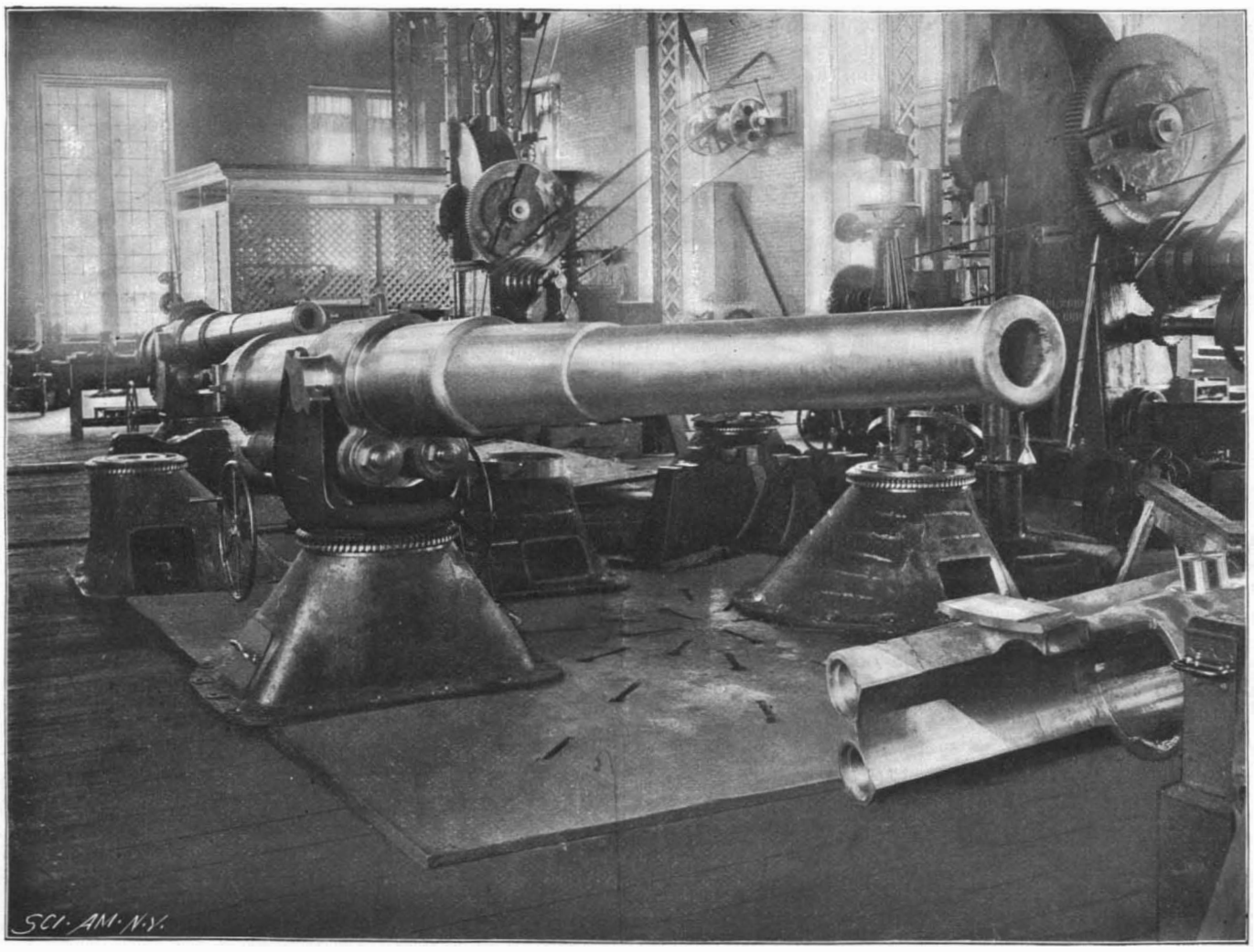
From the left of the tray a second lever extends, which carries a projection at its end which goes into an under-cut groove on the center extension of the plug. To this bar, termed the translating arm, the hand lever is pivoted. The pivot bolt can be seen in the cut. Now the second motion begins. The hand lever is swung still further to the right, and now the second lever moves or swings with it and draws the breech plug out of the screw box and upon the tray. The end of this lever is shown in one of the cuts crossing the hand lever and resting on it. As the breech block comes back it strikes the cartridge extracting hook and carries it back with it. This gives a hammer blow to start the shell and then the hook draws it quietly back.

Hitherto a spring latch has held the tray in position against the face of the breech. This latch is now tripped or released and the third phase begins. The hand lever continues on its right hand swing, the tray swings with it, carrying the breech plug off to right, and the breech is opened. Our cuts show the breech open and the final phase of operations completed.

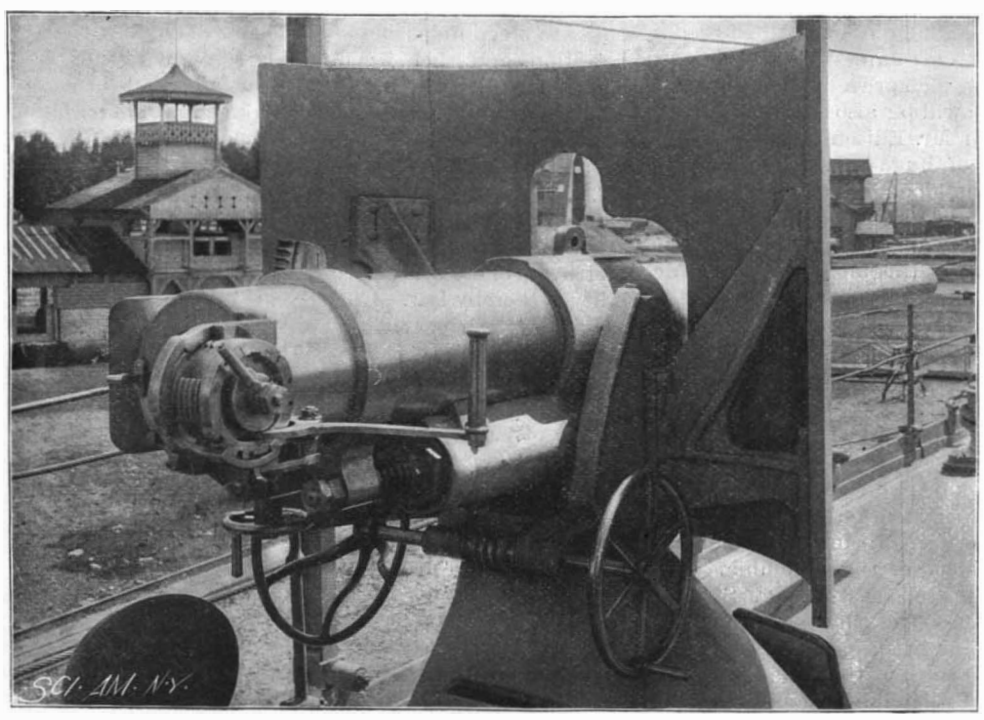
The reverse sequence closes the breech. Although for convenience divided into three phases, there is no break in the movement. The hand lever swings with unbroken sweep from left to right. The shell is drawn almost out. The gunners have to effect the final withdrawal by hand.

On reference to the cut, a cylindrical tube will be seen extending obliquely upward from the center of the breech plug. This operates in connection with the electric firing device. Within it a bar works back and forth, being forced outward by a stiff spring. As the breech plug is rotated this rotates with it and in the closing operation it is swung down to a horizontal position, and the projecting end of the small bar, striking an oblique abutment piece on the breech, is driven inward and held so. This closes a gap in the electric circuit. By closing the circuit by hand the primer is caused to operate and the gun is discharged. But if the breech plug has not been fully rotated, the bar will not be forced in and the electric primer will not operate.

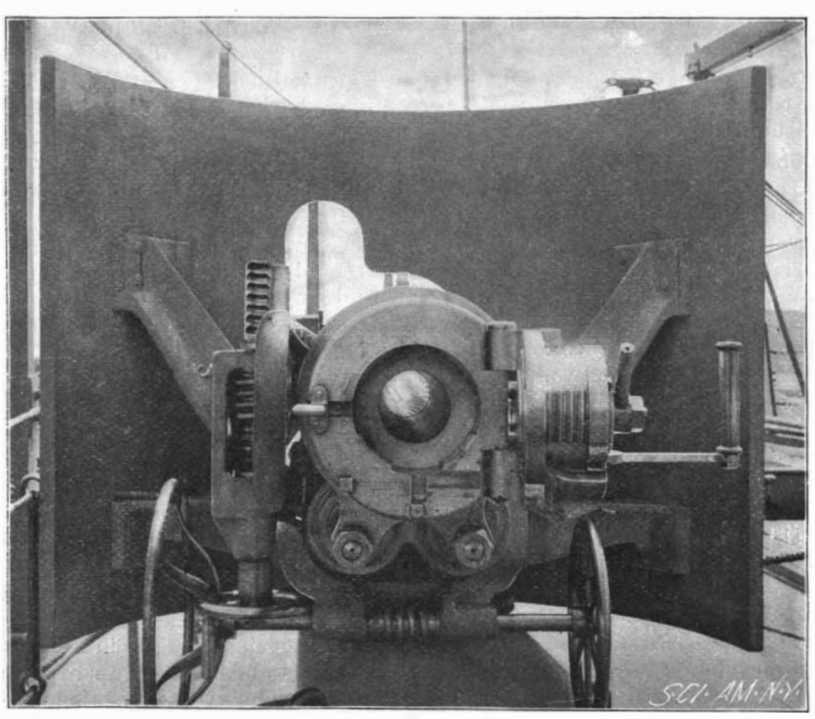
The illustrations of the 4-inch gun were taken by our artist on board the gunboat "Helena."



NAVAL 6-INCH RAPID FIRE GUN IN WASHINGTON GUN SHOP.



4-INCH RAPID-FIRE GUN, SHOWING DASHIELL BREECH MECHANISM.



SAME GUN WITH BREECH OPEN.

THE average rate of wages in Corea is 7 pence a day.

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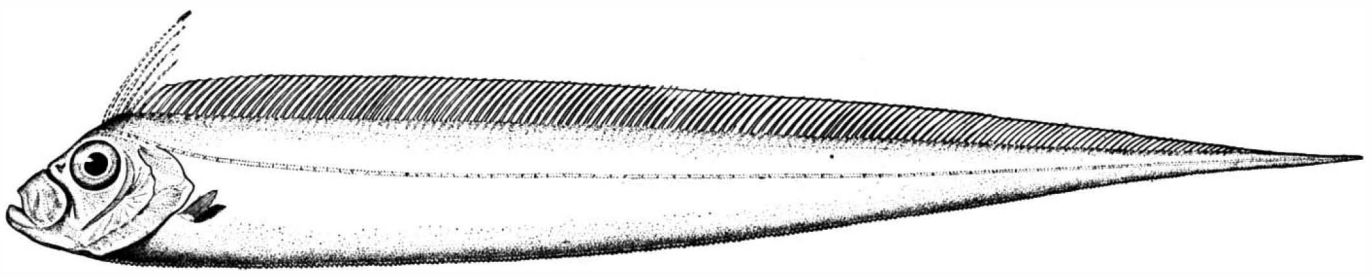
NOTICE OF A NEW RIBBON FISH FROM THE COAST OF OREGON.

BY HUGH M. SMITH, M.D., UNITED STATES FISH COMMISSION.

The ribbon fishes are among the most interesting and least known of the many remarkable fishes inhabiting the depths of the sea. Their large size, great fragility and habits make them very rare in collections. Their shape is bandlike; they are sometimes 20 feet long and only 10 or 12 inches deep, the thickness of the body being but a few inches. By some ichthyological writers, these fishes are supposed, from their shape and extraordinary length, to be the basis of "sea serpent" yarns. When they reach the surface of the water, the expansion of the contained gases causes the disintegration of their tissues, and they are consequently nearly always more or less mutilated when found. It is not known at what depth they live, and no specimens have ever been obtained by the use of the deep sea trawl or dredge. They are only discovered when floating dead at the surface or stranded on the shore.



NEW RIBBON FISH FROM THE COAST OF OREGON.

These fishes are very rare in American waters; they are not known to inhabit the waters of the western Atlantic, but have been taken on the coasts of Europe and at several places in the Pacific Ocean.

On the night of July 1, 1897, a large ribbon fish was taken in Rogue River, near Wedderburn, Oregon, at a point three-fourths of a mile above the river's mouth in water perfectly fresh. The fish was caught by being gilled in a salmon drift net and was alive when removed from the net. It was taken to Mr. R D. Hume, the well known salmon canner and cultivator, who recognized its rarity, but was unable to preserve it. He, however, employed an artist to make a sketch of it; took notes on its size, form, color, fins, scales, etc.; made a photograph of it; and forwarded drawing, photographic negative and information to the United States Fish Commission. While the failure to secure this specimen for examination and preservation is very unfortunate, the data on hand regarding it seem sufficiently complete to warrant this notice. Following is a description of the fish, which, in honor of its discoverer, it is proposed to name Trachypterus humei.

Body much elongated, moderately compressed, deepest and thickest at junction with head and tapering regularly backward, terminating in a point. Greatest depth, one-eighth total body length; dorsal and ventral outlines similar; ventral margin, minutely serrate.

Head short and deep; its length contained $7\frac{2}{3}$ times in total length of fish; its greatest depth, 6-7 of its length. Eye large, placed well forward; its diameter contained three times in length of head, once in snout. Mouth slightly oblique, exceedingly protractile, with no teeth on jaws Maxillary very short and broad—as broad as eye—the free margin rounded, extending slightly beyond anterior edge of eye. Mandible rather long; its length contained $1\frac{2}{5}$ times in head, extending to a point under posterior edge of pupil.

Dorsal fin very long and continuous, consisting of about 145 weak spines connected by an extremely delicate membrane, the fin beginning over a point halfway between the posterior margin of eye and gill opening and extending to within six inches of end of body; the rays not much elevated, highest anteriorly and gradually becoming lower posteriorly, the first four or five rays produced (torn in specimen and actual length not known). Pectoral short and pointed, about as long as eye; anal and ventral fins absent; apparently no caudal fin, the body terminating in a rather sharp point and, in the specimen described, showing no indications of a fin.

Scales very small and numerous, their average diameter about $\frac{1}{8}$ of an inch. Lateral line smooth, conspicuous, complete and nearly straight. Color, uniformly bright silvery, without any markings.

The length of the fish was 6 feet 6 inches; its greatest depth was 10 inches; the largest part of the body was about $3\frac{1}{2}$ inches thick and the head was about a foot long. The flesh was very soft and flabby. The premaxillary bones were remarkably protractile, and after death readily permitted the elongation of the mouth downward until the length of the head was doubled, giving the appearance of a horse's head.

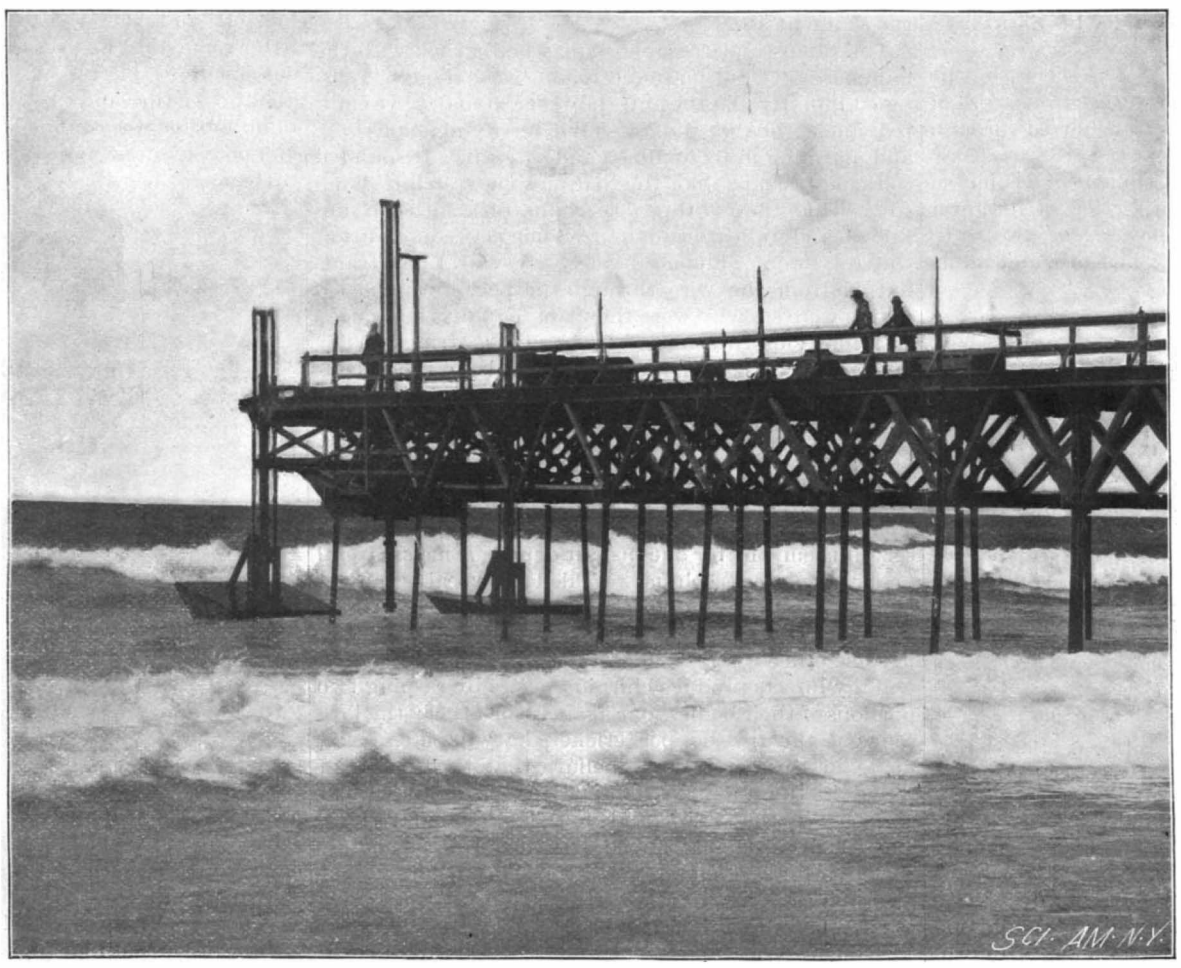
The specimen was a female, containing transparent, ripe eggs, of which a vialful was sent to Washington. The eggs are free, buoyant and one-seventh of an inch in diameter.

In the Proceedings of the California Academy of Sciences, vol. iv., 1893-4, Drs. Jordan and Gilbert have described a new ribbon fish (Trachypterus rex-salmonorum), based on a specimen 17 inches long, taken in the open sea off San Francisco Bay. This seems to be the only other species of Trachypterus known from American waters, the few specimens of ribbon fish previously taken on the Pacific coast of the United States and identified as Trachypterus altivelis probably being referable to T. rex-salmonorum. The Makah Indians, of the Northwest coast, are said to be acquainted with this fish. Among them it is known as the "king of the salmon," and its destruction is thought to have an injurious effect on the salmon fishing.

Trachypterus humei differs from the foregoing species in a number of essential particulars, among which are the absence of a fleshy crest on the nape, the lower dorsal fin, the absence of ventral fins, the shorter and wider maxillary, and the plain coloration, the other species being marked by large black or dusky blotches and bars on the body and head.

THE NEW WAVE MOTOR.

No one who has ever studied the wave movement of the ocean has failed to realize the millions of horse power being wasted daily along the various coasts of the country. The great difficulty has been to utilize this mighty power of the ocean waves so as to transform it into a steady, constant mechanical power. The problem is how to change the unsteady, intermittent power of the waves into a steady, constant power required for the operation of machinery and at the same time to prevent destruction of the plant during frequent periods of storm. The solution of this problem has engaged the attention of many inventors, and we give one of these solutions which appears to be successful. The Wright wave motor has been installed by the Los Angeles Ocean Power Company, which built its first experimental wharf at Potencia Beach, Cal., in January, 1897. Public tests were soon after made in the presence of many witnesses, and, encouraged by the results of these experiments, the company was organized in March of the same year, and they have expended $2,000 to extend and enlarge the plant. The wharf has a metallic structure which extends out about 350 feet into the ocean. At the outer end of this wharf or pier the wave motor plant was installed, consisting of three floats, and the other necessary machinery was situated on the bank. The motor is operated by a series of floats, 10 × 10 feet, made of planks or boiler iron and loaded with cement to give a weight twenty-five per cent greater than the displacement. The floats are connected directly to the piston of the water pump, and, as the floats are securely fastened by rollers to a perpendicular iron framework, they move only in a vertical plane actuated by the waves. The side of the float facing the incoming wave is inclined 30 degrees, so as to utilize the force of the wave to lift the float. The waves give a piston travel of 12 feet per minute on the average. The maximum travel per wave is 8 feet and the minimum is 6 inches. The waves average three to five per minute. The pistons operated by the floats have an area of 33 inches.



WAVE MOTOR AT POTENCIA, CALIFORNIA.

No power is taken when the floats rise, but the weight is utilized in the descent. This provides against any excessive pressure, as the floats will remain suspended when the pressure reaches 350 pounds. When the float descends, it forces water through an ordinary check valve into a reservoir on the bank. The reservoir has a large air space in the top. From this receiver the water is utilized at 200 to 400 pounds pressure. The pressure tank serves to equalize the power from wave to wave and in turn furnishes absolutely reliable and automatic means of regulating the power obtained; so that, during periods of excessive wave movement, as in storms, no more than a given amount of power can be obtained from this mechanism, and during times of danger it practically furls its own sails, as it were. This is done by the accumulated pressure in the pressure tank exerting itself upon the pump pistons so as to offset the weight of the floats tending to draw the pistons down. The water is forced by the compressed air in the tank through a nozzle upon the buckets of a Pelton water wheel, which it drives at a high rate of speed. The latter is connected with a dynamo, but, of course, other machinery may be substituted. From the Pelton wheel the water drops back into the reservoir from which it was originally pumped, and the same water is thus used over and over again without waste, thus reversing the old maxim that "the mill will never grind with the water that has passed." It is a curious example of the transformation of energy.

Each float develops about 2 to 3 horse power. From December 1st to the 16th the average number of waves was about six and the average piston travel was about 14 to 15 feet per minute. The average pressure developed in pounds per square inch was about 162. The average number of cubic feet per minute discharged per float was about 4. The horse power varied from 2·3 to 3·5. Nine electric lights were used to demonstrate the steadiness of the power. It is thought that motors to generate 1,000 horse power, including all of the construction work, without the electrical generators, would cost $110,000 on the Pacific coast and much less on the Atlantic coast. The promoters consider that power at the seaboard will not cost more than $13 per year per horse power, including six per cent on the investment.

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THE EARS OF WORMS, CRUSTACEANS AND ANTS.

BY JAMES WEIR, JR., M.D.

Some recent investigations and experiments, carried out in my laboratory, have shown me that many of the very lowest of animals possess the sense of hearing, and that some of them even possess the power of tonal discrimination, showing clearly, by their actions, that musical sounds are pleasing or disagreeable, as the case may be. In our own ears, sound waves are transmitted from the ear drums through the small bones of the middle ear, the so-called "stirrup," "hammer" and "anvil," on into the inner ear, where they strike a peculiar arrangement of microscopic plates resembling somewhat the ivory keys of a piano. These plates or plaques are called the plates of Corti, and each plate vibrates in unison with some particular number of sound waves. The range of true tonal or musical discrimination in the human ear ranges from notes produced by from about twenty-seven vibrations per second to notes produced by five or six thousand vibrations per second. Some ears are able to hear much lower or much higher notes, while in other ears, some of the plates of Corti that register the highest and lowest notes seem to be absent. Thus, in my own case, I am unable to hear the lowest note when the keyboard comprises or reaches the seventh C; again, in the case of a friend, he is unable to hear the highest note (A″), of the organ when the piccolo stop is drawn.

Supported by these facts, and by deductions derived from certain experiments which will be detailed further along in this paper, I have come to the conclusion that many of the lower animals are capable of hearing sounds whose vibrations are so many or so few to the second, that our ears are unable to perceive them.

The lowest sound that the human ear is able to detect, is produced, probably, by about twelve vibrations per second, while the highest reaches about thirty-five thousand vibrations per second. By experiment, I think that I have actually demonstrated the fact that ants hear sounds that are produced by vibrations exceeding sixty thousand per second.

In a former paper ("The Senses in the Lower Animals," North American Review, February, 1894), I showed that common angle worms not only possess the senses of touch, taste and smell, but that they also, (Darwin to the contrary, notwithstanding), possess the sense of sight to a certain extent being able to discriminate between light and darkness by means of exceedingly primitive ocelli or pseudo sight organs.

Further study of these creatures leads me to the conclusion that they likewise possess organs of hearing.

If I tap with a pencil on the surface of the earth in my vermicularium, or vessel containing worms, the little animals will soon emerge from their holes and cast themselves about on all sides, as if in search of the noise which has aroused them from their slumber. The schoolboy performs the same experiment when he pounds the earth in search of bait for his Saturday's fishing.

Darwin was perfectly well aware of this fact, but he attributed the movements of the worms to a sense of discomfort arising from vibrations transmitted through the earth and felt by them.

Now, if the third caudal or tail segment of a common angle worm be frozen, and a thin section of its lower surface be placed beneath a low-power lens, two oval, pinkish bodies lying immediately beneath, and adherent to the skin, can be readily made out. When the section is stained with eosin, these little organs become quite visible even to the naked eye. Two nerves start from these bodies, (one from each), and end in a ganglionic enlargement of the noto chord or central nerve.

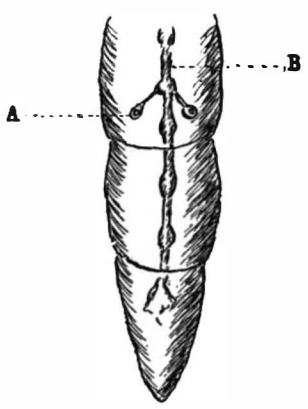

Fig. 1.

Auditory Organs of Earthworm (L. terrestris). A, auditory organ; B, noto chord.

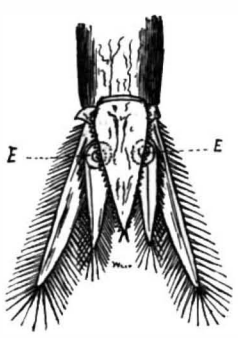

Fig. 2.

Tail of Shrimp. E, auditory organs (after Lubbock).

If these bodies be removed and the worm be restored to the vermicularium, no amount of pounding will bring it from its hole during the day. Reasoning, by exclusion and by analogy, (the shrimp, not many steps higher than the worm, has its ears in its tail), I conclude that the bodies are organs of hearing, and that the worm actually hears the sound of the pencil's impact on the surface of its home.

The ears of ants are situated in their legs. If an ant's leg be examined, a curious enlargement of its canal will be at once observed. In the femur or thigh, the diameter of this canal is $\frac{1}{3000}$ of an inch, but when it enters the tibia it swells to the diameter of $\frac{1}{2000}$ of an inch, then contracts to $\frac{1}{700}$ of an inch, and then again, at the end of the tibia, expands to $\frac{1}{500}$ of an inch. At the upper sac, where it contracts, there is a conical, striated organ which bears some resemblance to the organ of Corti in our own ears. A special nerve arises in the sensorium, the terminal filaments of which are spread out over this peculiar conical body. The thin integument of the leg, where the canal is swollen or enlarged into sacs, forms a very efficient ear drum.

Experiments with tuning forks, whistles, etc., on ants, produced nothing definite, and I came to the conclusion that they did not hear sounds emanating from these instruments on account of the, to them, slow rate of vibration. I therefore resolved to construct an apparatus that would, in my opinion, produce an extraordinary number of vibrations per second. With the assistance of a mechanical friend, by careful manipulation and after many failures, I made a wire, much thinner than a human hair, almost microscopic, in fact. This wire was tightly stretched between two pegs fastened in a board.

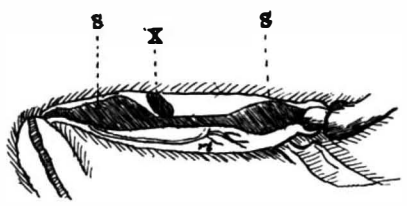

Fig. 3.

Tibia of Yellow Ant (L. flavus) slightly modified, from Lubbock. S S, swellings of large trachea; X, chordo tonal organ.

Taking the diameter of the wire, its tension, its length and the force of impact when I struck it with a small wooden hammer dressed in goldbeater's skin, we calculated that it would produce a sound having over 60,000 vibrations per second. Whether we were absolutely correct in our calculations, I am not prepared to state; yet I emphatically affirm that this instrument produced a remarkable effect on ants (L. niger) when any of them strayed near it and it was struck.

The behavior of the ants on such occasions was striking and peculiar. They would crouch down closely to the surface of the table, their antennæ moving rapidly and continuously; then, as though greatly alarmed, they would rush off at their greatest speed. I tried this experiment time and again, always with the same result. They were never alarmed when I struck guitar strings stretched between pegs; in fact, they went on their way without appearing to notice the sound at all.

The almost microscopic wire, when struck with the hammer, gave out no sound to my ears, though I listened intently. To the ants, however, it may have emitted, and probably did, a sound terrifying, startling, and alarming in its loudness and intensity. It sounded to them, perhaps, like the roar of some terrible monster, or like the awful peal, perhaps, of a hitherto unknown and unheard thunder. Some may contend that the ants were influenced solely by vibrations transmitted from the wire through the pegs to the board. If this were so, why were they not equally influenced by vibrations transmitted from guitar strings? The evidence seems to me to indicate and to prove conclusively that they were influenced by the sound of the wire vibrating many thousand times per second.

I am convinced that ants are deaf to all sounds heard by human ears, yet hear sounds that the ear of man is utterly incapable of detecting. That ants communicate with one another no one who has observed them will for one instant deny. A most careful and systematic search has revealed no vocal organs in ants such as the mammalia possess, consequently, if they communicate by sounds, they must produce them in some other way.

Many insects produce chirping noises by rasping two portions of their bodies, one against the other; the love songs of the grasshopper, cricket, katydid, etc., being made in this manner. I believe that the organs of sound in the ant are triangular spots on the upper surfaces of the third and fourth abdominal rings. These spots are finely ribbed, and when rubbed against the adjacent abdominal rings, as has been pointed out by Lubbock, must produce stridulation. From twelve to fifteen well-marked ribs or ridges will be found occupying a space about one-hundredth of an inch in length; and since we know that allied insects use a similar contrivance, (only it is situated in other portions of their bodies), for the purpose of producing sound, it is reasonable to presume that the ant does so likewise. Because we do not hear sounds produced by ants, is no reason for asserting that they do not make sounds, for, as I have explained, our ears can hear only sounds of so many vibrations; above and below a certain number of vibrations per second we are deaf.

A scientific note in Appleton's Popular Science Monthly, of recent date, states that certain observers distinctly heard ants making chirping or stridulating sounds, therefore it can be positively asserted that ants hear; for, if they have sound-producing organs, it necessarily follows that they have organs of hearing also.

At the bases of a lobster's antennæ are to be found two cul de sacs or pouches, one for each antenna. These are the creature's ears. The external covering or skin of these pouches is a continuation of the body covering, though somewhat modified in structure. In each pouch are always to be found several minute grains of sand, and these grains of sand play prominent rôles in the drama of audition, as experienced by the animal under discussion. The microscope shows that the floors of the ear pouches are papilomatous, or dotted thickly with minute papules or elevations, each surmounted by a hair. If one of these papules be examined with a high-power lens, a terminal nerve tuft will be found ensheathed in its thin walls; a microscopic nervule leads from it, together with thousands of its fellows, to the auditory nerve, which passes on into the sensorium. This description of a lobster's ears is derived from a careful study of fresh specimens, and is, I think, correct in all essential details.

In our own ears are to be found certain little stone-like bodies called "otoliths," which subserve a very useful purpose in audition. As I have stated above, small grains of sand are always to be found in the ears of lobsters; likewise, if the exuviæ or cast-off skins of lobsters be examined, minute sand grains will be found in the discarded ear pouches. These animals have discovered that these artificial otoliths increase their acuteness of hearing, therefore, manage to supply these adjuvants to audition from the ocean's bed.

A German scientist, Prof. Hassen, proved that they really do this by the following experiment, which I myself have likewise performed with complete success.

Taking advantage of the lobster's habit of exuviation, Hassen placed one, which was about to shed its skin, in a receptacle in which there was strained sea water, and in which there were no grains of sand. As soon as it had cast its old skin, he placed it in another basin of strained sea water, in which he had scattered some crystals of uric acid.

In a day or so he examined the ears of the lobster, and found in them certain crystals which, upon being tested, gave out the characteristic reaction of uric acid, thus showing that the lobster had sought out these unique otoliths, and had placed them in its ears.

Water is a good conductor of sound, and the lobster's ears are, therefore, very useful organs. It is warned by them of the approach of its enemy or its prey. I am convinced that it is able to hear any disturbance in the sand bed or rock bed of its house at the distance of two or three feet.

In 1889, while in New York, I procured some fine lobsters, and made them the subjects of careful study. After removing the eyes of one of them, I took a slender sliver or splinter of wood, and, drawing its point about over the sandy bottom of the tank in which the blind lobster was confined, could attract its attention, and occasion it to approach in the direction of the disturbance, when the point of the stick was two feet away. When it had arrived within a short distance of the point of disturbance, it would rush forward and endeavor to seize the splinter with its claw.

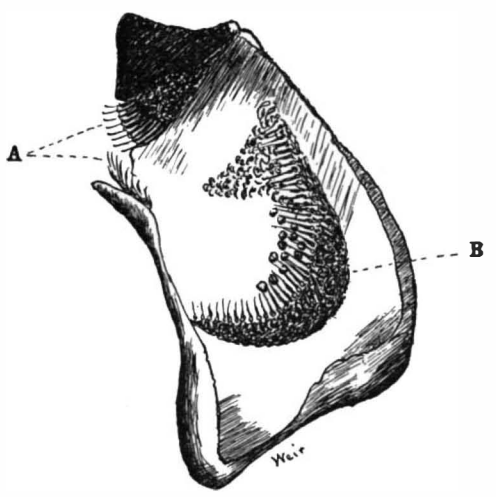

Fig. 4.

Ear of Lobster (modified from Farre). A, orifice; B, auditory hairs and sand grains ("otoliths").

A shrimp was placed in the tank and was observed as soon as it began to crawl. I am convinced that the lobster heard the footsteps of the shrimp, improbable as it may seem.

THE colors for signal lamps have been made the subject of a letter ballot by the Railway Signaling Club, with the following results: 26 for red (danger) and green (clear); 9 for red (danger) and white (clear); 3 for other arrangements. This represents a strong opinion in favor of the elimination of the white light for signals on the part of the men who manufacture and have **charge of signal equipment.**

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MYSTERIOUS VASE.

BY W. B. CAULK.

Tricks performed with ink and water have always been favorites with magicians, and they have devised means of keeping this trick fully abreast of the times, thus retaining its popularity. The manner of performing the latest ink trick involves such novel principles as to puzzle even those who are well posted on modern magic. The Mysterious Vase has been presented by but few prestidigitators, and the secret so well guarded that comparatively few people know how it is done.

The attention of the audience is called to a glass vase that is filled with water which is resting on a light stand. This vase resembles a large octagon celery glass. In the vase there are a few cut flowers, which the performer removes as he calls attention to the vase and the clear water it contains. The flowers are given to the ladies in the audience, as they have no further connection with the trick.

A lady's handkerchief is borrowed and the vase covered with it for a moment. On removing the handkerchief, the water that was seen in the vase appears to have changed to ink. While this rapid transformation is very startling, yet the most marvelous part of the trick is to come. The magician bares his forearm, that the audience may see that his sleeves have no connection with the trick, and then proceeds to remove from the ink in the vase six silk handkerchiefs and two lighted candles, each article being perfectly dry.

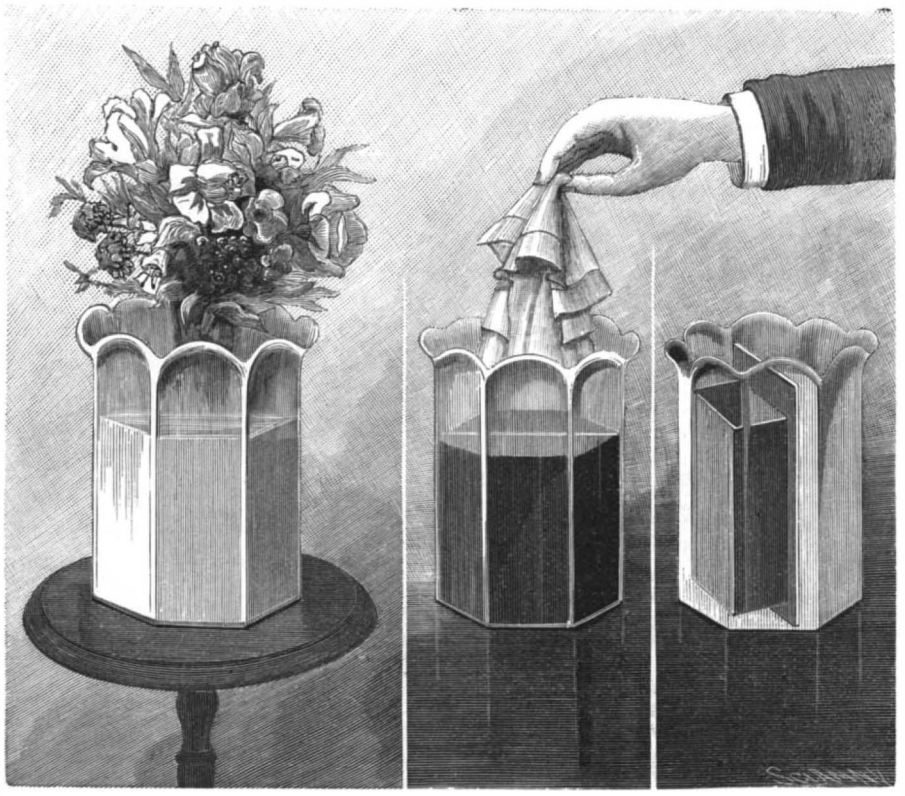
The means by which this seeming impossibility is performed are as simple as the trick is mysterious, as the following will show. In the center of the vase, reaching from side to side and from the bottom to within a half inch of the top, is a piece of polished mirror. The side edges of the mirror rest in the angles of the vase, and as the vase is only seen from the front, the edges are not seen. The front half of the vase being reflected in the mirror leaves the impression that one is looking directly through the vase, when in reality you only see one-half of the inside.

To the back of this mirror is attached a watertight tin box, in which are placed six small silk handkerchiefs and two candles. The exterior of the box and back of the mirror are painted a dead black color. Enough water is poured into the vase to reach the top edge of the mirror. In the water is dissolved a small portion of iron protosulphate. A few cut flowers are placed in the vase, which is then placed on the stand with the mirror side to the audience, and the candles lighted.

After the flowers are removed and a handkerchief borrowed, the magician secures possession of and palms between his fingers a small lozenge made of pyrogallic acid, which he drops in the water in front of the mirror in the act of covering the vase with the handkerchief. In a very few moments the lozenge dissolves, and the pyrogallic acid of which it is composed causes the water, which holds in solution the iron protosulphate, to change to a good black ink.

On removing the handkerchief with which the vase was covered, ink is seen to have taken the place of the water, and from the center of the vase the performer removes the silk handkerchiefs and candles.

The first section of our engraving shows the vase of water on the stand; the second shows the vase after the water has changed to ink, with the magician removing one of the silk handkerchiefs. The third illustration represents the vase with one side broken away, showing attached to the back of the mirror the tin receptacle that contains the handkerchiefs and candles.



THE MYSTERIOUS VASE.

The Value of Trade Marks.

The trade mark is essential; it is a protection to the honest maker and a menace to the dishonest maker; it is a protection to the buyer, and he realizes it even to the extent of, in many instances, paying more for the article bearing it, perhaps after his merchant has assured him that "here is something as good, or better, for less."

Two articles may look alike as two peas, but offer them for sale at the same time and place, for the same price, one bearing a well-known trade mark, the other unmarked, and every time the marked one sells first. Why is it? Because, in this day and age, imitation and fraud has invaded every line of business, and the buyer must, to a greater or less extent, deal on faith; but he is not going wholly on faith if he can help it. A trade mark is a mark of identification that cannot be mistaken, even by the ignorant, and when once well and favorably known, its merits are explained by father to son, mother to daughter, and the high standing of the article bearing it assured so long as the manufacturer is careful to keep it up to the standard and fully abreast of the times.—Machinery.

MRS. TYNDALL, the widow of Prof. Tyndall, has remitted to the Royal Institution a sum of £1,000 which she states that her husband desired her, at such time as should be convenient to herself, to present as an expression of his attachment to the institution with which he was so long connected, and of his sympathy with its objects.

RECENTLY PATENTED INVENTIONS.

Engineering.

STEAM ENGINE.—William F. and Eugene W. Cleveland, Rounthwaite, Manitoba, Canada. This invention presents an improvement on a formerly patented invention of the same inventors, relating more particularly to a locomotive or tandem engine, whereby a greater or lesser vacuum is produced in the exhaust ends of the cylinder by an induction or suction action of the piston exhaust of one engine on the valve or auxiliary exhaust of the other engine. The two cylinders have their main or piston exhausts and auxiliary or valve exhausts so arranged that the main exhaust of one engine cylinder produces a suction on the auxiliary exhaust of the other cylinder. The larger exhaust area, with prompter action and without dividing the steam, increases the velocity of the latter, or it is less retarded and heavier draught is produced.

ROTARY ENGINE.—Martin C. Kessler, Gilead, Ind. This invention relates chiefly to the wear surfaces and packing of rotary engines, and provides improvements whereby leakage of steam is prevented. The rotary piston hub has radial and lengthwise slots in which the pistons proper are slidably arranged, while segmental packing pieces arranged at the ends of the hub have radial grooves to receive the ends of the pistons. Each piston is supported and forced outward by pressure applied at its center only, so that its outer or wearing surface may automatically adjust itself to the contact or friction surface of the casing with the greatest facility and exactness.

RAILWAY WATER TANK.—William M. Stevenson and William K. Bailey, Honey Grove, Tex. This invention provides a simple construction by means of which a railway train may be utilized to lift water from a well to the tank, a large upright tube or barrel extending down into the well, and there being over the barrel a derrick-like frame affording guides for a crosshead to which is connected a plunger operating in the barrel, there being a tackle block at the top of the derrick, and a pumping cable adapted to be connected with the locomotive. A wire or rod line is supported at the side of the track in both directions, to form a guide for the pumping cable, which has a link or ring sliding on the wire. When a train stops, going either way, the locomotive is connected with the cable, and the pumping is effected as the train starts, lifting the plunger and a column of water, the cable being detached by a tripper striking a post.

Electrical.

ARC LAMP.—Edgard Weber, Paris, France. According to this invention the carbon holders are connected by a cord or small chain, one holder being heavier than the other to actuate them, and the cord passing around a disk mounted loosely on the spindle of which are armatures connected with a mechanical brake acting on the disk, and submitted to the action of a spring or counterweight, an electro-magnet arranged in shunt on the main circuit. When the voltage increases at the lamp terminals and the electro-magnet receives a proportional quantity of the current, the mechanical brake is released and magnetic braking is exerted upon the disk in such manner that the carbons approach each other slowly, regularly and without jerks, being slightly drawn back as soon as they have made contact.

Bicycles, Etc.

BICYCLE FRAME.—Amos B. Simonds, Youngstown, O. This invention provides novel means for establishing a spring connection between the frame and one of the axles, whereby the two may have a degree of independent movement, relieving the sides of jarring in riding over a rough road. Auxiliary frames are attached to the back stays and members of the rear fork, and admit of independent movement of the wheel in an arc struck from the crank axle, without interfering with the operation of the chain and sprocket driving gear.

Mechanical.

SELF-OILING WHEEL.—Ivor R. Titus and John W. Ensign, Huntington, W. Va. The wheel hub, according to this invention, is adapted to hold a quantity of oil in such a manner as to supply it to the bearing in sufficient quantity to properly lubricate the journal in the most economical manner. Means are also provided for the exclusion of dust from the journal, and for supplying oil without the removal of plugs and other devices, a better surface than the ordinary cotters being furnished to receive the wear on the end of the hub. The wheel may be quickly removed and replaced in case repairs are needed.

AUTOMATIC LUBRICATOR.—Alexander A. DeWitt, New York City. This lubricator is applicable to cylinders, pipes, chests and bearings of engines, its construction adapting it for use on a great range of machinery. It comprises a pump on the rod of which are two striking points or tappets, one movable relative to the other, an actuating cam revolving between the striking points, while a threaded rod mounted longitudinally on the piston rod engages and moves the adjustable striking point. The operator can govern the delivery of lubricating material to suit the machine with but little care and at the least possible cost for the lubricator.

METHOD OF PATCHING SAWS.—Michael D. Ahearn, Green Bay, Wis. To repair fractures in metal plates, according to this invention, the metal on one side is cut away directly across the line of the fracture, to form a lateral recess and reduce the edges of the fracture to a feather edge, a corresponding splice piece being then inlaid and brazed within the recess and across the fracture. The method is designed to insure a strong and permanent patch for the repair of broken, cracked or fractured mill and other saws or steel plates, or for the insertion of broken-out teeth, the crack having its edges so cut away that it does not have any tendency to creep to a greater depth, and the saws not being shortened.

COMBINATION IMPLEMENT.—Charles J. Ericson, Salt Lake City, Utah. An improved tool for mechanics is provided by this inventor, one adapted to be readily changed in adjustment to serve as a square, a bevel gage, spacing dividers, and a pencil compass. Its stock piece is formed of sheet metal and has side pieces held together by an integral web, the sides having right-angular flanges in the same plane and terminating at one end in laterally perforated ears, one side having a pointed toe at the end opposite the ear.

FLUID METER OR MOTOR.—John H. Dixon, Marietta, O. This invention provides an apparatus in which a casing incloses a rotary shaft having paddles or blades against which the incoming fluid may act, the apparatus being so constructed that it may also be used in connection with a meter to record the amount of fluid passed through it, the latter being effected by a simple system of gears and dials which may be readily adjusted with reference to the known quantity of fluid passing through.

KNIFE SHARPENER.—John W. Maillot, New York City. According to this invention a pair of blocks is formed with complementary wavy surfaces which are brought close together and are composed of an abrading material, the knife to be sharpened being drawn lengthwise in the angle formed between these surfaces. The blocks may be formed as a single block or as two separate blocks held together by an inclosing frame, and they may be made of vitrified emery throughout, or of clay, cement, or other material readily shaped and cheaply manufactured, their outer curved surfaces being of emery or other abrading material.

COLLAR FOLDING AND SHAPING MACHINE.—Antoninus Farina, New York City. This invention provides a machine designed to expeditiously and effectively fold collars without injuring them, the machine folding and shaping turn-down and roll collars, and shaping the wings of wing collars. In addition to ironing and shaping the collar, the machine smoothes down any parts of the fiber which may project in a torn state, thus making the collar regular at its crease and preventing it from irritating the neck of the wearer.

Miscellaneous.

RECOVERING ZINC OXIDES FROM SOLUTIONS OR ORES CONTAINING ZINC.—Edgar A. Ashcroft, Newcastle, N. S. W. To obtain zinc oxide from ores or solutions containing zinc, in a cheaper and more convenient manner than heretofore, this inventor provides a process for first obtaining from the ore or solution solutions of zinc sulphate, adding zinc oxide and stirring the mixture until a pasty consistency is obtained, and heating the product to convert it into zinc oxide, sulphuric or sulphurous acid being disengaged. In neutral zinc solutions the zinc salt is first converted into basic zinc salt by the addition of zinc oxide, carbon being then intimately mixed with the basic zinc salt, and the mixture heated to about the melting point of aluminum.

GAS LIGHTER.—Thomas N. McNish, Kearney, N. J. This inventor has devised a hand gas lighter which consists of a stationary taper-receiving tube in connection with a revoluble key independent of the taper-carrying tube, and adapted to be operated by the thumb of the hand grasping the handle of the device. The gas may be turned on and lighted without danger of marring or in any way injuring any ornamental work, and the device is simple and inexpensive.

MANIFOLDING CASH SALES BOOK.—John H. Murphy, New York City. This invention provides an improvement on a formerly patented invention of the same inventor, whereby the sales book or counter check book is arranged to enable the salesman or other person to quickly and conveniently produce three or more sales slips simultaneously. Each leaf of the book is formed into three or four separable slips or sections, the slips being folded over, and a corresponding number of transfer sheets being employed.

COLLAPSIBLE BOX.—Henry H Kinsey, Shoshone, Idaho. This invention provides a novel construction of "knockdown" boxes for the transportation of eggs, bottled milk, crackers, etc., the box being also designed to serve as a convenience in the household when desired. The end pieces have detachable hinge connection with the bottom piece, and the side pieces engage slideways in the end pieces, while the cover has flanges which engage over the end pieces, and is secured in place by removable fastening devices.

LACE OR RIBBON CABINET.—Charles H. Martin, Marshall, Ill. For holding and displaying ribbons, laces and similar goods, this inventor has devised a cabinet which is divided centrally and the rear portion hinged to the front, so that it may be swung to the side, thus exposing the inner portions to facilitate the removal or replacing of goods. The two parts of the cabinet are secured together by a latch, and brackets are attached to horizontal bars extending across the front and rear faces, both faces of the cabinet, between the horizontal bars, having glass strips, making it possible to see the spools in the cabinet and ascertain when the stock becomes reduced.

WAGON BRAKE.—Joseph A. Gilkey, Springfield, Oregon. According to this invention, a spring adapted to be attached to the hounds or other fixed portion of the running gear is so made and located that it will take up all the slack in the brake and its coupling, and when the brake is not applied the spring will act to carry and hold the brake beam and shoes or blocks away from the wheels, preventing the accumulation of mud on the shoes or blocks. The spring also prevents the brake bar or beam from swinging endwise, but does not interfere in any manner with the action of the brake mechanism.

GARDEN TOOL.—Libbie B. Smith, Belle Plain, Iowa. This invention relates to improvements in hoes, rakes and diggers of various kinds, and provides a handle having an adjustable head, so that a number of different kinds of garden implements may be attached thereto, the head being so made that the various tools when attached may be adjusted and yet be retained in such position that the lower or operating points or parts will be level when the implement is held in position for use. Any form of garden tool may be made to be attached to this head.

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TAIL PIECE FOR MUSICAL INSTRUMENTS.—Robert E. Lackner, Paragould, Ark. In stringed instruments, this invention provides means by which the tension of the strings may be readily increased or relaxed. The tail piece has two members connected by an eccentric with each other, whereby one of the members may be moved forward and rearward.

COOKING APPARATUS.—George D. Fox, Buffalo, N. Y. To facilitate roasting meats, etc., this invention provides a pan in which the meat may be thoroughly basted as often as required by operating a handle on the exterior of the pan. The pan is preferably cylindrical, divided into two longitudinal sections and held on a base to stand properly in the oven. Supported at a little distance above the bottom of the pan is a platform on which is placed the meat to be cooked, while below this platform extends a scoop adapted to receive the juices or gravy of the meat, the scoop being held so as to be revolved by a crank, by which means the juices of the meat may be taken up and poured over the meat, thus making unnecessary the hot and unpleasant work of basting by hand.

EGG BEATER.—Frank S. Bellanger, Waterbury, Conn. The frame of this beater is preferably made of a single piece of wire formed of parallel guideways connected with a handle, and also formed into short outer arms by doubling the wire, while the beater which revolves in the frame is likewise formed of a single piece of wire bent to form fingers to be revolved between the arms, such rotation being effected by moving a nut up and down on a screw rod which extends up between the guideways.

BED.—Elbert E. Munger, Spencer, Iowa. According to this invention, a mattress frame is mounted to rock on and swing within the bed frame, a leg hinged to one end of the mattress frame being capable of holding it in tilted position, while a seat is adjustably held by the bed frame and two limb supports are hinged to the seat board, means being provided for supporting the free ends of the limb supports. The mattress may be crimped and folded to form a comfortable cushion upon the seat board and easy back and limb rests when the mattress support is swung into inclined position.

Designs.

PARASOL.—Oscar M. Arnold, New York City. A design for parasols to correspond with tailor-made gowns has been patented by this inventor, the ornamentation of the parasol consisting of raised and continuous embroidery ornamentation.

BICYCLE TOE CLIP.—David Basch, New York City. This toe clip has a horizontal body portion, a drop member and a toe piece, and the peculiarity of the design is in that portion of the clip which connects with the pedal, there being hook extensions of the body portion projecting rearward of the drop member.

SHOE HORN CLAMP.—William E. Gregory, Astoria, Oregon. This is a device for use in connection with a shoe horn, with which it has pivotal connection, and by means of which the horn may be clamped on the back seam as it is used to guide the foot to place in the shoe.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co. for 10 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS, ETC.

SHOP AND ROAD TESTING OF DYNAMOS AND MOTORS. By Eugene C. Parham, Electrician of Johnstown Steel Motor Company, and John C. Shedd, Professor of Physics, Marietta College. New York: The W. J. Johnston Company. Pp. 576. Price $2.

The authors have here provided a manual which is the outcome of their experience on the testing floor and road, and which is designed to be alike helpful to the student fresh from text book examinations and the self-taught practical man. The book is designed to give a complete theory of the commercial testing floor, so far as it relates to direct current machines, and of the applications of theory to practice, while also meeting the demand of operating companies for a manual that will enable them to do their own repair work and testing.

THE CALORIFIC POWER OF FUELS. By Herman Poole, F.C.S. New York: John Wiley & Sons. Pp. 279. Price $3.

This book treats of a large and complex subject, in which engineers are always interested. The work was originally commenced by the author as a translation of M. Scheurer-Kestner's "Ponvoir Calorifique des Combustibles," changes in which have been made to adapt it to American methods and data, and there has been added a collection of tables of heats of combustion of fuels, solid, liquid and gaseous. The work embraces only that portion of calorimetric determinations having a bearing on fuel values, and a concise description is given of the leading calorimeters, with some examples of working and calculations. In an appendix is the report of the committee on boiler tests of the American Society of Mechanical Engineers, December, 1897.

ANGEWANDTE ELEKTROCHEMIE. Zweiter Band. Anorganische Elektrochemie. Erste Abtheilung. Elektrochemie der Metalloide und der Alkalimetalle. Von Dr. Franz Peters Leipzig: A. Hartleben's Verlag. 1898. Pp. 248. Elektro-technische Bibliothek. Band XLVIII.

ANGEWANDTE ELEKTROCHEMIE. Zweiter Band. Anorganische Elektrochemie. Zweite Abtheilung. Elektrochemie der Erdalkali, Erd und Schwermetalle. Von Dr. Franz Peters. Leipzig: A. Hartleben's Verlag. Elektro-technische Bibliothek. Band XLIX. 1898. Pp. 215.

LA PHOTOGRAPHIE ET L'ETUDE DES NUAGES. James Boyer. Paris: C. Mendel, publisher. 1898. Pp. 80. Price 40 cents.

The various observations recommended by the International Meteorological Congress for the observation of the clouds are given. The work was terminated in 1897. The present book gives details as to the method employed in photographing the clouds, and gives excellent examples of the results obtained.

THE X RAYS. Their Production and Application. By Frederick Strange Kolle, M.D. New York. Pp. 191. Price $1.25.

In the present volume it has been the specific aim of the author to present to the reader, student or surgeon a concise treatise on the use and value of Prof. Roentgen's discovery.

ALUMINUM. The Pittsburg Reduction Company, Pittsburg, Pa. Second edition. 1898. Pp. 266, 16mo. Price $1.50.

Though this book may be looked upon somewhat in the line of a trade publication, still it is of the greatest possible value. We do not know of any book on aluminum which contains so much practical information regarding the working of aluminum. It does not pretend to go into the subject of the manufacture of aluminum, like Richards' large work, but it is filled with valuable points for those who use aluminum in any form. It is eminently fitting that a publication of this kind should be issued by the largest producers of the metal in America, as no one is so well qualified to give reliable information regarding the metal. The arrangement of the book is excellent, and the supplementary tables are valuable. It is edited by Alfred E. Hunt, S.B.

RESULTS OF RAIN, RIVER AND EVAPORATION OBSERVATIONS. Made in New South Wales during 1896. With maps and diagrams. By H. C. Russell, Government Astronomer. Sydney: Department of Public Instruction. Meteorology of New South Wales. 1897. Pp. 209.

A CATALOGUE OF EARTHQUAKES ON THE PACIFIC COAST, 1769 TO 1897. By Edward S. Holden, LL.D. Smithsonian Miscellaneous Collections, 1087. Washington. 1898. Pp. 254.

THE LOCOMOTIVE. Published by the Hartford Steam Boiler Inspection and Insurance Company. New Series, No. XVII. Hartford, Conn. 1897. Pp. 191.

REPORT OF THE COMMISSIONER FOR THE YEAR ENDING JUNE 30, 1897. United States Commission of Fish and Fisheries. John J. Brice, Commissioner. Part XXIII. Washington. 1898.

L'ALGERIE. Le Sol et les Habitants, Flore, Faune, Géologie, Anthropologie, Ressources Agricoles et Economiques. Par J. A. Battandier and L. Trabut. Paris: Baillière et Fils. 1898. Pp. 360.

The Mechanical Engineer is the title of a new paper published by the Scientific Publishing Company, of Manchester, England. It is edited by the well known engineer, William H. Fowler. A careful examination of the first few numbers has proved very satisfactory. There has been no question that a paper of this kind has been needed in England for some time past. We are glad to see it is being conducted with a special view to accuracy—a point which our Transatlantic brethren are not conspicuous for, specially regarding those things relating to America. There seems to be a brilliant future for this paper. The subscription price in the Postal Union is 25 shillings. It is excellently illustrated, and among the departments are: "Our Contemporaries," "Book Reviews," "Railroad Notes," "Electrical Notes," "Shipping Notes," "Industrial Notes" and "Correspondence."

Mahatma is a paper devoted to the interests of the magician, etc., has been revised and gives promise of a considerable popularity among those who are interested in magic. It is published by G. H. Little & Company, 493 Sixth Avenue, New York City, N. Y. Subscription price is $1 per year.

We have received the descriptive catalogue of the Institute for Home Study of Engineering, Cleveland, Ohio. We judge from an examination of this catalogue that the Institute is well equipped for giving courses to those who are unable to attend a college or scientific school. This method of instruction is becoming deservedly popular, and the institution to which we refer seems to be well equipped for giving instructions of this nature. The instructors are all practical men with college educations who had considerable experience in actual work. All those thinking of taking a course in steam, electrical, mechanical, or hydraulic engineering should send for this catalogue.

Received.

"The Georgian Period," being measured drawings of colonial work, is the title of a series of handsome portfolios now being published by The American Architect and Building News, of which we have received Part I. They include some fine gelatine prints, and illustrate the details of domestic and public buildings in the New England, Middle and Southern States.

Some Homes built by Wendell & Smith is the title of a book in paper covers containing numerous well executed half tone illustrations from photographs of modern houses built by the publishers at Overbrook, Pelham, Wayne and St. David's, Pennsylvania. Copies may be had by addressing Wendell & Smith, Philadelphia, Pa.

Easy Lessons in Mechanical Drawing and Machine Design. By T. G. A. Meyer. New York: Arnold Publishing House. We have received Part I. of Volume I. of this excellently printed work, which is well adapted for beginners and students desiring to learn practical mechanical drawing. Price 50 cents.

Business and Personal.

The charge for insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in the following week's issue.

Marine Iron Works. Chicago. Catalogue free.

"U. S." Metal Polish. Indianapolis. Samples free.

Emery, etc., etc. The Tanite Co., Stroudsburg, Pa.

Gasoline Brazing Forge, Turner Brass Works, Chicago

Yankee Notions. Waterbury Button Co., Waterb'y, Ct.

Bicycle Electric Light Co., Cleveland, O., want agents.

Handle & Spoke Mchy. Ober Lathe Co., Chagrin Falls, O.

FERRACUTE Machine Co., Bridgeton, N. J. Full line of Presses, Dies and other Sheet Metal Machinery.

Improved Bicycle Machinery of every description. The Garvin Machine Co., Spring and Varick Sts., N. Y.

Gasoline Engines and Launches. Free catalogue. Monitor Vapor Engine and P. Co. Grand Rapids, Mich.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

☞ Send for new and complete catalogue of Scientific and other Books for sale by Munn & Co., 361 Broadway, New York. Free on application.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7414) W. J. W. asks: 1. Is not glass a non-conductor, and are the glass insulators used on the cross arms of poles so that no current can pass into the pole? A. Yes. 2. Will a growing tree conduct electricity or is it a non-conductor? A. Wet wood is a fairly good conductor. Dry wood is not. 3. Should the wires be carried through trees and in some cases actually wired onto the boughs? A. We think this is a bad practice, particularly to have the wires loose, so that they can swing and rub upon the boughs. 4. What would be the result if both wires should be rubbed bare on a tree (that is, the insulation rubbed off)? A. There would be a great deal of current lost by leakage. 5. Is there sufficient strength in 100 volts to seriously injure one, if wires should be broken and came in contact with a person passing by? A. No, if the current is direct, except an arc should form so as to burn him. There would be no shock through the body from 100 volts. If the current is alternating, it would be more than any one could safely receive. 6. Does the gage of wire make a difference in the strength of current? A. The size of wire is determined by the amperes of current it is to carry without overheating. 7. Does the current have the same effect on a person if standing on ground or on wood floor? A. That depends upon dryness and dampness, as in 2 above.

(7415) S. says: Please inform me how to back a map or other drawing with muslin, so it will lie smooth and not wrinkle; and if common flour paste will answer, and if the paste is put on the paper or cloth, etc. A. Stretch your muslin (ordinary cotton stuff) on a wooden stretcher by means of tacks; cover your map on the back with an even and thin coat of good boiled starch or flour paste or other sticking material, no matter what, if it only sticks. Lay the map on the cloth, only taking care to do this smoothly and to avoid wrinkles; rub it evenly down after temporarily covering the place you rub with a piece of clean paper, so as to avoid friction over the map itself. Let it dry, and the work is done. In order to avoid wrinkles, it is quite essential to let your paper map, after being covered with the starch paste, soak for a few minutes, so as to give the paper a chance to expand from the moisture. It will then, while contracting from the drying, obtain a very smoothly stretched surface.

(7416) F. E. writes: 1. I came in possession of an aneroid barometer and do not fully understand its markings. The outer circle is marked from 0 to 15,000 feet altitude; the inner circle, from 17 to 31 inches atmospheric pressure; but there are, besides the markings, rain, change, fair, on the north of the dial, and I cannot understand to what use they are put in case I am on the top of a mountain of 8,000 feet when the hand points south. A. The use of words rain, fair, clear, dry, etc., on a barometer is a survival of an old practice. These words have no connection whatever with the indications of the weather by the instrument and would be entirely wrong at different altitudes. With a falling barometer, storm is predicted; with a rising barometer, clear weather is indicated. 2. And what is the object of making the outer circle movable all round? A. The outer circle of your barometer, upon which feet are marked, is to be used as follows: Set the circle with its 0 feet coinciding with the index at any time. As one climbs or descends mountains, the barometer will then indicate his change of altitude. If this circle were set at the sea level, it would show one's altitude above sea level. This ring must be movable, to admit of adjustment to the rising and falling of the barometer.

(7417) D. McG. asks how to preserve a white pine flag pole (large size), leaving the sap wood on, the sap is somewhat thick, and to trim it off will reduce the pole too much. Would coal tar be better than white lead? Would like a lasting material and a preserving one as well, and at the same time not expensive. A. Answer by B. F. Fernow, Chief of Forestry Division, United States Department of Agriculture. No paints or coal tar are to be considered a satisfactory preservative to be applied to a flag pole with the sap wood left on. The best preservative for such a purpose is carbolineum, or any other heavy coal tar oils will answer. The pole should be left to season, under roof if possible, and the carbolineum should be supplied when the pole is dry. There are various brands of this preservative to be had, each claiming superiority. The so-called carbolineum avenarius is to be had through the Carbolineum Wood Preserving Company, Nashville, Tenn. Another, cheaper and perhaps for this purpose just as serviceable material is sold by Brume, Grosche & Company, 59 Terrace, Buffalo, N. Y. A half or five-eighths inch rod of iron will answer for the protection of a single pole like this from lightning. Joints should be coupled with firm screw couplings.

(7418) P. B. K. asks: 1. What would be the result if the wire gauze should be left out of an acetylene gas burner, and the orifice in the burner tip should become enlarged so as to allow the flame to enter the service pipes? A. Should there be no mixture of air with the acetylene, the gas would burn at the mouth of the pipe as ordinary gas does, but if any air is mixed with the gas, there would be an explosion. 2. Would it be advisable to force the gas through about one inch of water between the gas generator and the service pipes in the building as a precaution against the flame reaching the generator? A. A water seal is not necessary if proper care is exercised to prevent air from mixing with the acetylene gas. The holder should be thoroughly blown out to remove all the air before attempting to light the gas.

(7419) G. W. P. asks (1) how to make an induction coil for an experimental telephone transmitter. A. The induction coil of the Blake transmitter has a primary winding of about 180 turns of No. 22 A. W. G. single-covered copper wire, and the secondary coil has over 4,000 turns of No. 27 A. W. G. similar wire. The coil is made in the same manner as any other induction coil for a light current. For Blake transmitter see SCIENTIFIC AMERICAN SUPPLEMENT, No. 250, 10 cents by mail. 2. How are strong magnets made, of what kind of steel and temper? A. Permanent magnets should be made from the best tool steel, tempered hard at the ends only, but left soft in the middle. Stubs' or Jessup's steel is commonly used. They are best charged by inserting them in a coil of wire through which a current of electricity is flowing. 3. A neighbor and myself have made a Hopkins (Bell) telephone which works ¼ of a mile with ground return. How can we make an inexpensive signaling device? A. There are numerous signaling devices. SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 162, 966, 10 cents each, will give you instruction with drawing for making several forms. 4. What can we employ as the simplest and best in the way of a lightning arrester for our experimental telephone? A. Lightning protection for telephones is treated in SCIENTIFIC AMERICAN SUPPLEMENT, No. 652, 10 cents. The ordinary saw tooth lightning arrester of telegraph instruments will probably serve your purpose.

(7420) H. M. M. asks: Is it good practice to varnish or shellac the disks of a Wimshurst influence machine, when vulcanite is used in place of glass? If so, may the shellac cover the tinfoil segments (except where the brushes of the neutralizer touch)? Is the 18 inch disk machine described in one of your SUPPLEMENTS of sufficient capacity for X ray work? A. The varnishing of the glass plates of Wimshurst and other static machines is to prevent the deposition of moisture upon them, since glass is very hygroscopic. It is not necessary to varnish well polished vulcanite, though there is no objection to doing so. The tinfoil can be left without shellac. For X ray work plates 18 inches in diameter may be used, but they must run very fast, 1,800 to 2,500 turns a minute, and there should be at least two revolving plates.

(7421) E. H. P. asks: 1. Is there a substance the thickness of paper or pasteboard through which the magnet would have no attraction for a needle? If so, what is it? A. A plate of sheet iron will produce this effect, and iron is the only known substance which will do so. 2. How long will a six-inch horse shoe magnet hold its attractive power with or without the armature? A. It is a matter of difficulty to so use a magnet as not to weaken its magnetism. Whenever the magnet is not in use, its armature should be on the poles. In this condition its magnetism will be retained for any length of time without change. If it be left without an armature, it is liable to loss of strength. It will also lose strength if the armature is slammed upon the poles, though the strength is not weakened by suddenly pulling the armature off the poles.

TO INVENTORS.

An experience of fifty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted APRIL 19, 1898,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Acetosulfanilate, making alkaline, Schaerges & Schwarz	602,646
Acetyl derivative of phenetidin, Schaerges & Schwarz	602,690
Acid, producing orthotoluene sulfonic, W. Dieterle	602,682

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